

EFFECTS OF THE *ACHILLES KIDS* GUIDED RUNNING PROGRAM ON HEALTH-  
RELATED FITNESS AND SELF-CONCEPT IN ADOLESCENTS AND YOUNG  
ADULTS WITH INTELLECTUAL DISABILITIES: A PILOT STUDY

by

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# **The University of Utah Graduate School**

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## ABSTRACT

Obesity prevalence is soaring among adolescents and young adults. Adolescents and young adults with intellectual disabilities are no exception. In fact, they are more physically inactive, have lower cardiorespiratory fitness (CRF), and higher body mass indexes (BMI) than their nondisabled peers. In addition, they have less differentiated and more global self-concepts than their age-matched peers without intellectual disabilities.

The present study examined the effects of an 8-week *Achilles Kids* guided running program on 6-minute walk distance (6MWD), resting heart rate (RHR), BMI, waist circumference (WC), and global self-concept (GSC) for nine adolescents and young adults with intellectual disabilities. It was hypothesized that there would be greater improvements in 6MWD, RHR, BMI, and WC after 8 weeks of the guided running program than after 8 weeks of the usual adapted physical education program.

Additionally, it was hypothesized that there would be a treatment phase by time interaction such that eight weekly bouts of running exercise would yield a greater increase in global self-concept than eight weekly classes of adapted physical education.

Through the use of a split-plot middle graphing technique, this study found that seven of the nine participants had evidence of some intervention-related improvement in 6MWD, RHR, or WC ( $p \leq 0.031$ ). Study participants, on average, spent 77% of their sampled exercise bouts within the THRZ during the intervention phase and only 39% of

their sampled exercise bouts within the THRZ during the control phase. There was a significant two-way interaction between the experimental phase and acute exercise in the “I want to stay as I am” global self-concept item ( $p = 0.04$ ), such that the exercise bouts yielded a greater increase in the second global self-concept item during the intervention than during the control phase.

The conclusion is that the *Achilles Kids* guided running program may help to improve the health-related fitness and global self-concept of adolescents and young adults with intellectual disabilities. However, future trials of longer duration, in multiple schools, and with progressively increasing doses of exercise are needed to fully document the efficacy and effectiveness of the *Achilles Kids* program.

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## CHAPTER 1

### INTRODUCTION

#### Achilles International

Achilles International is a distance running organization for individuals with both intellectual and physical disabilities. The organization was started in 1983 by Dick Traum, who was the first amputee to run the New York City Marathon. It is a nonprofit organization with members and chapters in over 70 countries and 20 states in the United States, but no chapters have yet been started in Utah. The mission for each Achilles chapter is “to enable people with all types of disabilities to participate in mainstream athletics in order to promote personal achievement, enhance self-esteem, and lower barriers to living a fulfilling life (<http://www.achillesinternational.org/>).” All over the world, Achilles International is building a supportive environment for individuals with disabilities to train with able-bodied volunteers. Achilles International’s signature event is the Hope and Possibility Five-Miler, which provides an opportunity for able-bodied runners to participate side-by-side with athletes with disabilities. Additionally, the Hope and Possibility Five-Miler race contains several award categories for individuals with disabilities, allowing a first place finish to be a possibility for athletes who have never before had this opportunity.

Achilles International has expanded to include specific programs for children and war veterans with disabilities. The organization provides training, racing opportunities, and an in-school program for children. It also brings running programs and marathon opportunities to military personnel with disabilities returning from the Middle East. The broad objective of Achilles International is “to bring hope, inspiration and the joys of achievement to people with disabilities (<http://www.achillesinternational.org/>).”

### Achilles Kids

Achilles International’s program for children is called the *Achilles Kids Program*, and it includes the following components: *Races and Workouts*, *Future Marathoners Club*, and *Run to Learn*. The *Races and Workouts* component allows children with disabilities to be paired with able-bodied volunteers who provide training assistance and encouragement. The New York City chapter sponsors year-round workouts for the children and two big racing events per year for the children with disabilities and their non-disabled siblings. The *Future Marathoners Club* is for children of 10 years of age or older who have the desire to run or walk a marathon when they turn 18. The purpose of this program is for the children to learn to set goals and challenge themselves.

The *Run to Learn* component, which was started in 1995 and is guiding this study, is a program implemented in adapted physical education classes to encourage children with special needs to run, walk, or roll in their wheelchairs. Throughout the year, the children complete a virtual marathon and keep track of their progress on maps, lap charts, and training log books provided by *Achilles Kids*. Laps are counted, converted to miles, and then charted on 26.2 mile maps, which include mile landmarks that are located in the cities of the participating schools and are familiar to the children. The children are



positively reinforced with rewards such as t-shirts, certificates, athlete of the month posters, medals and, lastly, running shoes for completing the virtual marathon. The students' log books contain training tips and stretches that are explained to the children by the adapted physical education teachers. This program is of no cost to the teachers implementing it or to the students participating in it, but rather is supported from donations and the hard work of the many Achilles volunteers. *Achilles Kids* also provides ways for the classroom teachers to incorporate what the children are learning through *Run to Learn* into classroom settings (<http://www.achillesinternational.org/>).

### Significance

The Centers for Disease Control and Prevention (CDC) have declared obesity to be an epidemic (Wallace, 2003). The fitness levels of individuals with disabilities are generally lower than the fitness levels of their nondisabled peers (Dunn & Leitschuh, 2010). Accordingly, the body mass indexes (BMI) of individuals with disabilities tend to be higher, on average, than those of their non-disabled peers (Pitetti & Fernhall, 2004). High BMI values are particularly evident in individuals with Down syndrome (Pitetti & Fernhall, 2004). Moreover, adolescents with intellectual disabilities have suboptimal levels of cardiorespiratory fitness as a result of factors such as sedentary lifestyle and hypotonia (Elmahgoub et al., 2009). These lower levels of cardiorespiratory fitness in adolescents with intellectual disabilities increase their risk for obesity, type 2 diabetes, and elevated cardiovascular disease risk factors (Elmahgoub et al., 2009).

The *Healthy People 2010* guidelines strongly recommend increasing physical activity and fitness for people with and without disabilities (Department of Health and Human Services, 2000). The research in the area of physical activity for youth with

developmental disabilities is scarce, and future research is needed in the area to examine the possible benefits of physical activity on this population (Johnson, 2009). Parents may be more likely to provide opportunities for physical activity to their children with disabilities if research can demonstrate that specific physical or mental health-related benefits are attainable (Johnson, 2009). Additionally, professionals will have a greater ability to make more specific and efficacious physical activity recommendations for children and adolescents with developmental disabilities if research can document health-related benefits (Johnson, 2009).

Lack of motivation is a potential barrier to participating in endurance activities for individuals with intellectual disabilities, which may in turn contribute to lower cardiorespiratory fitness (Lavay, McCubbin, & Eichstaedt, 1995). The efficacy of primary and secondary reinforcement techniques was shown in a study conducted on adolescents with moderate intellectual disabilities participating in a repeated and timed one-mile walk/jog (Taylor, French, Kinnison, & O'Brien, 1998). In this study, five adolescents with intellectual disabilities experienced improved performance in the timed one-mile walk/jog when receiving reinforcement in the form of verbal praise and verbal praise plus tokens exchanged for food as compared to their performance in the one-mile walk/jog when receiving no reinforcers (Taylor et al., 1998). Primary reinforcers are reinforcers that satisfy a biological need such as a drink of water when thirsty. Secondary reinforcers are reinforcers that individuals have learned to like such as a cartoon smiling face sticker (Lavay, French, & Henderson, 2006). The findings of Taylor et al. (1998) were consistent with the efficacy of reinforcement techniques shown in a study in which three young adult females with Down syndrome increased their exercise behavior on a

cycle ergometer when a token economy was used versus when the token economy reinforcement technique was not used (Bennett, Eisenman, French, Henderson, & Shultz, 1989). A token economy system is a delayed method of reinforcement, in which individuals receive a token immediately following successful performance of the desired behavior (Lavay et al., 2006). The tokens can later be exchanged for reinforcers.

The *Achilles Kids* running program places substantial importance on the use of reinforcement techniques to increase motivation of the participants. The students receive stamps to mark on the *Achilles* map immediately following each session. Once their virtual marathon is complete, the students receive certificates and t-shirts as reinforcers. Additionally, having the children track their running by mapping their completed mileage across their own state helps them to learn about goal-setting while maintaining excitement and motivation towards running (Hill, 2000).

To successfully participate in mainstream society, adolescents and young adults with intellectual disabilities need to maintain a balanced and realistic level of self-concept (Mañano, Be'garie, Morin, & Ninot, 2009). Self-concept refers to the perception, evaluation, beliefs, and feelings that a person holds in regard to himself or herself (Harter, 1999). Physical self-concept is especially important when considering successful interaction with nondisabled peers. Physical activity provides an avenue to increase self-concept, and therefore increase the chances of these individuals becoming more involved in mainstream society. Physical activity-related improvements in self-concept, in turn, may increase the likelihood that lifetime physical activity may be adopted. Lifetime physical activity is a particularly important preventive health goal for those with

intellectual disabilities, who are at increased risk for costly and debilitating diseases such as cardiovascular disease and type 2 diabetes.

In summary, there is a need for further run training research studies in adolescents and young adults with intellectual disabilities. The *Achilles Kids* organization is interested in starting their *Run to Learn* program in Salt Lake City, UT. Therefore, this study was intended to serve as a means of determining the efficacy of this specific *Achilles Kids* endurance training program in Salt Lake City. The results of this pilot study may help to provide preliminary data for future external grant applications that could provide seminal insight into the type and duration of the exercise intervention needed to more thoroughly document the health-related fitness and self-concept benefits of a program like the *Achilles Kids Run to Learn* program that could be implemented by adapted physical educators within the city, across the State, and possibly, across the country.

### Specific Aims and Hypotheses

*Aim #1:* To determine whether an 8-week *Achilles Kids* guided running program would improve the cardiorespiratory fitness of adolescents and young adults with intellectual disabilities more than an 8-week adapted physical education program (a “usual care” control).

*Hypothesis:* Eight weeks of the *Achilles Kids* guided running program would *increase* the **6-minute walk distance (6MWD)** and *decrease* the **resting heart rate (RHR)** to a greater extent than 8 weeks of adapted physical education in 11 adolescents and young adults with intellectual disabilities.

*Aim #2:* To determine whether an 8-week *Achilles Kids* guided running program would improve the **body composition** of adolescents and young adults with intellectual disabilities more than an 8-week adapted physical education program (a “usual care” control).

*Hypothesis:* Eight weeks of the *Achilles Kids* guided running program would reduce the age-related gains in **body mass index (BMI)** and the **waist circumference (WC)** to a greater extent than 8 weeks of adapted physical education in 11 adolescents and young adults with intellectual disabilities.

*Aim #3:* To determine whether eight weekly bouts of exercise in the *Achilles Kids* guided running program would improve the **global self-concept** of adolescents and young adults with intellectual disabilities more than eight weekly adapted physical education classes (a “usual care” control).

*Hypothesis:* Eight weekly bouts of exercise in the *Achilles Kids* guided running program would improve global self-concept as measured by a six-item, graphical *global self-concept scale* more than eight weekly adapted physical education classes in 11 adolescents and young adults with intellectual disabilities.

### Limitations

The following limitations were recognized:

1. This study used a small sample size of nine participants from one special education class at a local high school, making it difficult to generalize the results.

2. The intervention in this study lasted only 8 weeks, which is not ideal when trying to detect health-related fitness changes. This is especially true for the body composition outcomes.
3. This study may have been affected by a lack of motivation of the participants, which may have reduced the proportion of activity time spent at a moderate- or hard-intensity. In turn, inadequate motivation to exercise at a sufficient intensity may have limited the ability to detect run program- versus adapted physical education-related differences in the 8 week changes in the 6MWD, the RHR, the BMI, and the WC (Taylor et al., 1998; Vashdi, Hutzler, & Roth, 2008).
4. This study focused on an endurance training mode, rather than an endurance plus resistance training mode, which may be more efficacious for improving body composition (Elmahgoub et al., 2009). Nevertheless, the single training mode studied herein is better able to attribute the potential for greater health-related fitness benefits to a single mode and prescription of exercise.
5. The seasons for the control and experimental phases were different, requiring more indoor activities during the second experimental phase than during the first control phase.
6. It is fully understood that history is the major threat to internal validity in a two-phase, single subject design. Although there was an initial consideration to randomly assign the participants to two separate order groups, this approach was ultimately rejected because of the likelihood that those assigned to receive the running program first and the control adapted physical education

program second would have likely yielded a biased subsample of participants in whom may have had more easily detected slope differences between study phases. In brief, the hypothesized fitness benefits of the running program, when received first, would be more likely to elevate fitness levels at the start of the adapted physical education program than if the adapted physical education program were received first. As a result of the law of the initial value (Haskell, 2001) and of regression to the mean, those participants who received the running program first would be more likely to experience fitness reductions during the subsequent adapted physical education program, thereby biasing the likelihood of detecting study phase-related differences in individual slope values. Therefore, we decided to have all participants receive the usual care (or control) adapted physical education program first and the running (or experimental) program second.

7. The six-item graphical self-concept scale for youth with intellectual disabilities has been validated only in France, which limits its generalizability to other countries.

### Delimitations

The following delimitations were recognized:

1. The running program and the adapted physical education class were held at the same time of day, the same number of days per week, and for the same duration of time per session to ensure that participants received the same

opportunity for activity outside of the academic classroom during each study phase.

2. Participants were tested on the four health-related fitness variables once per week, on the exact same day of the week (e.g., on Wednesdays to avoid Monday school holidays during the fall terms).
3. Heart rate during activity was measured during one 5-minute period in weeks four, six, and eight of each study phase to assess the adherence of the participants to the prescribed exercise intensity (e.g., percentage of time spent exercising in their target heart rate zones) and to national physical activity recommendations (DHHS, 2008).
4. Indoor facilities were reserved for days when weather did not permit outdoor activities.
5. The 6MWT was conducted indoors to allow weekly testing of cardiorespiratory fitness regardless of the weather.
6. A single subject design was used because of the difficulty of comparing participants who vary widely in age and disability.
7. Self-concept was measured on Fridays, as opposed to Wednesdays when the health-related fitness variables were measured. The reason for testing these variables on separate days was to allow for the participants to be physically active for a longer period of time before and after assessing self-concept. The testing of the health-related fitness variables on Wednesdays would not allow for as much physical activity time on those days.



### Assumptions

The following assumptions were recognized for this study:

1. Participants' physical activity time outside of the study would remain consistent for the duration of the study.
2. Participants' eating habits would remain consistent for the duration of the study.
3. Participants would display peak effort when completing the weekly 6MWT due to our use of three test administrators.
4. Each study participant would understand what the six faces mean on the graphical self-concept scale.
5. Global self-concept was solely selected, rather than global self-concept plus physical self-worth, physical condition, sport competence, physical attractiveness, and physical strength, to measure self-concept because individuals with intellectual disabilities appear to show more global and less differentiated self-concepts than their chronologic age-matched peers without intellectual disabilities (Dykens, Rosner, & Butterbaugh, 1998). It may be inappropriate to use instruments that are based on a multidimensional model of self-concept in individuals with intellectual disabilities (Dykens et al., 1998).

### Definition of Terms

The following list consists of terms that are encountered throughout the text.

**Autism** – A developmental disability that significantly affects social interaction as well as verbal and nonverbal communication. Other characteristics of autism include incessantly engaging in repetitive activities, resistance to changes in routine, and an inability to appropriately respond to perceptual stimuli, such as sounds and touch (Lavay et al., 2006).

**Body mass index (BMI)** – Used to assess weight relative to height. BMI is calculated by dividing body weight in kilograms by height in meters squared (Thompson, Gordon, & Pescatello, 2010).

**Cardiorespiratory fitness (CRF)** – A health-related component of physical fitness that is the ability of the circulatory and respiratory systems to supply oxygen during sustained physical activity. CRF is usually expressed as measured or estimated maximal oxygen uptake ( $VO_{2max}$ ) (DHHS, 2008).

**Celeration line** – Is constructed in each phase of a split-plot middle technique of data analysis to quantify the change in an outcome variable over time. The celeration line predicts the direction and the rate of change over time in the experimental and control phases of the study (Cook & Campbell, 1979; Kazdin, 1982).

**Down syndrome** – A specific type of intellectual disability resulting from a chromosomal defect or abnormality. Characteristics of Down syndrome can include a lag in physical growth, a less well-developed circulatory system including congenital heart disorders, poor respiration, susceptibility to respiratory infections, perceptual handicaps, poor balance, obesity, and hypotonicity (Dunn & Leitschuh, 2010).

**Intellectual disabilities (ID)** – Significantly subaverage general intellectual functioning, existing concurrently with deficits in adaptive behavior and manifested during the developmental period, that adversely affects a child’s educational performance (Dunn & Leitschuh, 2010).

**Positive reinforcement** – Offering something of value as a consequence of a desired behavior, which results in an increased frequency of that behavior (Lavay et al., 2006).

**Primary reinforcers** – Reinforcers that satisfy a biological need. Examples include reinforcing with food when hungry or with water when thirsty (Lavay et al., 2006).

**Secondary reinforcers** – Reinforcers that individuals have learned to like, such as receiving stickers (Lavay et al., 2006).

**Resting heart rate (RHR)** – The number of times the heart beats in one minute when no physical activity is taking place (Clover, 2001).

**Self-concept** – The perception, evaluation, beliefs, and feelings that a person holds in regard to himself or herself (Harter, 1999).

**Six-minute walk test (6MWT)** – Introduced in 1976 as a 12-minute walk test to determine exercise capacity for patients with respiratory disease, and later developed into the 6MWT. Although the correlation between the distance walked in the 6MWT and estimated VO<sub>2</sub>max is fairly low, the test is easy to administer, better tolerated, and reflects activities of daily living better than other walk tests (Morinder, Mattsson, Sollander, Marcus, & Larsson, 2009). The 6MWT is also used often in clinical settings because it is safe, simple, well-standardized, and inexpensive (Morinder et al., 2009). Participants are instructed to walk as far as they can back and forth along a 30 meter hallway for 6 minutes. Participants are permitted to stop and rest if necessary and resume

when they are ready (American Thoracic Society, 2002). The total distance walked is recorded.

**Six-minute walk distance (6MWD)** – The total distance walked by participants in the 6-minute walk test.

**Target heart rate zone** – Determined based on recommendations by the Department of Health and Human Services (DHHS) that moderate-intensity physical activity is performed at 40-59% of the heart rate reserve (HRR) and that hard-intensity physical activity is performed at 60-84% of the HRR (DHHS, 2008). Heart rate reserve (HRR) is the difference between the age-predicted maximal HR ( $220 - \text{age}$ ) and the resting heart rate (RHR). The lower limit of the target heart rate zone is calculated as  $(\text{HRR} \times 0.40) + \text{RHR}$ , and the upper limit of the target heart rate zone is calculated as  $(\text{HRR} \times 0.84) + \text{RHR}$  (ACSM, 2006).

**Token economy system** – A token economy system is a delayed method of reinforcement, in which individuals receive a token immediately following successful performance of the desired behavior. The tokens can later be exchanged for reinforcers (Lavay et al., 2006).

**Very Short Form of the Physical Self-Inventory adapted for individuals with intellectual disabilities (PSI-VSF-ID)** – An instrument used to measure self-concept in individuals with intellectual disabilities. Likert and graphical rating scales were designed that would simplify the measurement process of self-concept in this population. In addition, the words used in the 12 items of the PSI-VSF-ID were made easier to understand as compared to the original PSI-VSF, which was not designed for individuals with intellectual disabilities. The 12 items in the PSI-VSF-ID measure the following six

factors of the physical self-concept: global self-concept, physical self-worth, physical condition, sport competence, physical attractiveness, and physical strength. However, the questions that assess each factor of physical self-concept have been validated separately. This separate validity testing allows for the testing of one specific area, such as the sole testing of global self-concept that is being conducted in this study (Mañano et al., 2009).

**Waist circumference** – Waist circumference is a horizontal measure of abdominal adiposity that is taken at the narrowest part of the torso, between the ribs and iliac crest. This measurement is taken at the end of normal expiration and is measured in centimeters (Heyward & Wagner, 2004).

## CHAPTER 2

### LITERATURE REVIEW

#### Physical Activity Guidelines

*Healthy People 2010* contains a focus area devoted to increasing both physical activity and fitness for people with and without disabilities (DHHS, 2000). Previous studies have indicated that people with disabilities are less likely to be physically active and physically fit compared to their nondisabled peers (Johnson, 2009). Centers for Disease Control and Prevention (CDC, 2001) recommends at least 60 minutes of moderate intensity physical activity most days of the week, but preferably daily for school-aged children.

#### Consequences of Inactivity for Individuals with Disabilities

Due to the nature of many disabilities, sedentary lifestyles are common and may lead to secondary impairments that further compromise the health of individuals with disabilities. Examples of these secondary impairments are osteoporosis, osteoarthritis, obesity, and depression. Additionally, individuals with disabilities who lead fairly sedentary lifestyles tend to experience decreased balance, strength, endurance, and flexibility. These declines are typically exacerbated with age (Lahtinen, Rintala, & Malin, 2007).

### Benefits of Aerobic Exercise for Youth with Intellectual Disabilities

Halle, Gabler-Halle, and Chung (1999) found that participation in an aerobic walking and jogging program three times per week for 20 weeks led to a statistically significant decrease in resting heart rate for eight adolescents and young adults with intellectual disabilities. In this study, the control group did not significantly experience decreased resting heart rate values. It is important to note that a peer-mediated program was used in the Halle et al. study because this may have served as an additional method of reinforcement.

Millar, Fernhall, and Burkett (1993) used a randomized control trial to investigate the effects of a treadmill training program for 14 adolescents with Down syndrome. The participants took part in the program three times per week for 10 weeks. Statistically significant improvements were noted in walking capacity, but not aerobic capacity.

Lotan, Isakov, Kessel, and Merrick (2004) conducted an observational study using a repeated measures design to investigate the effects of treadmill training on 15 children with intellectual disabilities. The training program occurred daily for 3 months, and progressed from 5 minutes to 30 minutes, with an average session of 20 minutes. All 15 participants had statistically significant reductions in resting heart rate at the end of the study.

### Benefits of Combined Exercise Training for

#### Youth with Intellectual Disabilities

Fragala-Pinkham, Haley, and Goodgold (2006) used a single-group pretest-posttest design to study the effects of a community-based fitness program on 28 children

with developmental disabilities. The fitness program was held twice a week for 16 weeks and contained a 10-30 minute aerobic conditioning component, in addition to a warm-up, cool-down, and strengthening component. The outcome measures were isometric muscle strength, energy expenditure, functional mobility, and the Presidential Fitness Test. All outcome measures showed statistically significant improvement from baseline.

Dyer (1994) performed a repeated measures study on 10 children with Down syndrome, age 8-18 years, with IQs between 30 and 70. Four exercise sessions were performed per week for a total of 13 weeks. This program included a 22 minute endurance component, in addition to the warm-up, cool-down, and weight training components. RHR, blood pressure, and 3-minute step test measures were taken at weeks 1, 7, 13, and 19. Statistically significant differences were found in HR during the stress test. Systolic blood pressure decreased between weeks 1 and 7, and diastolic blood pressure decreased between weeks 1 and 7 and 1 and 13.

Elmahgoub et al. (2009) found that 15 adolescents with intellectual disabilities who participated in a 10-week combined exercise training program experienced significant decreases in weight, BMI, WC, and fat mass in comparison to the 15 adolescents in the control group. The combined exercise training program consisted of warming up for 5 minutes, cycling for 10 minutes, strength training of the biceps brachii and triceps brachii for 10 minutes, stepping for 10 minutes, strength training of the quadriceps and hamstrings for 10 minutes, and cooling down for 5 minutes. The adolescents in the control group did not receive the 10-week training program, but did participate in the daily school activities, which included physical education classes.



Furthermore, the participants in the intervention group covered 50 additional meters in the 6MWT from pretest to posttest, which led to a significant  $p$ -value of 0.04.

### Lack of Motivation

Regardless of how well a fitness program is designed for use in a population with individuals with disabilities, the program is unlikely to be successful without a component to address motivational issues. Halle et al. (1999) studied the effects of an exercise program for eight adolescents and young adults with disabilities that paired nondisabled peers with study participants to increase motivation levels. The program took place three times per week and consisted of a 5-minute warm-up, 20-minute walk/jog, and 5-minute cool-down. Participants in the intervention group experienced statistically significant decreases in RHR, while the control group participants did not have significant changes in RHR. The researchers noted that some participants needed additional motivators, such as tokens, to increase their participation levels.

Millar et al. (2003), whose treadmill study with adolescents and young adults with Down syndrome was discussed previously, did not find improvement in aerobic capacity. The researchers noted that adolescents and young adults with Down syndrome may not respond to exercise in a conventional manner. This unconventional response is largely due to lack of motivation, as the participants may not choose to increase their exercise intensity to levels that are uncomfortable. This failure to allow discomfort leads to a decreased training effect in this population. If motivation can be increased, adolescents and young adults with Down syndrome are much more likely to experience a training effect.

### Reinforcement Techniques

Taylor et al. (1998) studied the influence of verbal praise, tokens exchanged for food, and verbal praise plus tokens exchanged for food on a timed 1-mile walk/jog for five adolescents with intellectual disabilities. The participants improved their mile times when at least one of these reinforcement techniques was used. Although reinforcement was more advantageous than no reinforcement, there was not a certain type or combination of reinforcement that was more influential. The researchers concluded that motivation to perform aerobic activity regularly can enhance the cardiovascular fitness of adolescents with intellectual disabilities.

Hill (2000) discussed the benefits of using graphic feedback to help students to run across states by keeping track of their miles and representing them on a map. The *Achilles Kids Run to Learn* program uses this approach as a reinforcement technique to help children with intellectual disabilities learn to enjoy running and learn about other subjects and goal-setting along the way.

### Self-Concept

Castagno (2001) studied the effects of a Special Olympics unified basketball program on the physical self-competence of 58 adolescent males with intellectual disabilities. After participating in the basketball program, the participants scored significantly higher on the Self-Esteem Inventory (Zigler, 1994), the Adjective Checklist (Siperstein, 1980), the Friendship Activity Scale (Siperstein, 1980), and the Basketball Sports Skills Assessment (Special Olympics, 1992) than they had prior to beginning the program. Physical self-competence is part of the umbrella term, global self-concept, and

is often used in relation to physical activity. A balanced and realistic level of self-concept often provides individuals with disabilities an easier transition into mainstream society (Maïano, Be'garie, Morin, & Nonot, 2009). With a major goal for high school students with intellectual disabilities being to learn how to function in mainstream society, developing a balanced level of self-concept is crucial. Participation in adapted physical activity is one of the most effective ways to increase self-concept and prepare these students for mainstream society. Improvements in self-concept can be seen in a post-exercise bout and long-term.

#### Effects of Ethnicity on Physical Activity for Youth with Disabilities

Due to the fact that four out of the nine participants with useable data were Hispanic, it was important to research physical activity for children with disabilities in relation to the Hispanic population. Columna, Pyfer, and Senne (2011) found that Hispanic families value the benefits that physical activity provides to their children with disabilities. However, these families often face constraints that impact their physical recreation choices. As a result of these limited choices, Hispanic children with disabilities often lack adequate physical activity compared to their Caucasian peers.

#### Lifelong Physical Activity

So-Yeun (2008) discussed the importance of promoting lifelong physical activity among children with disabilities. Through proper individualized education program (IEP) goal setting, students with intellectual disabilities are more likely to be involved in physical activity upon completing high school. The *Achilles Kids* program provides

these students with activities that require minimal equipment and can be performed daily throughout the rest of their lives.

## CHAPTER 3

### METHODS

#### Study Design

We used a two-phase, single subject, repeated measures design to evaluate the slope differences in 6MWD, RHR, BMI, and WC between the control and experimental phases of the study. We also used a quasi-experimental repeated measures design to examine the interactive effects of study phase, intervention duration, and acute exercise on global self-concept. Each study phase was 8 weeks in duration, and all participants received the 8-week adapted physical education program first (control phase) and the 8-week running program second (experimental phase). Weekly testing of the four health-related fitness outcomes within each study phase allowed slope values to be determined for each condition and allowed us to determine whether the trends differed between the control and experimental phases.

Additionally, weekly testing of self-concept occurred before and after physical activity bouts in the control phase and intervention phase. Self-concept was measured using the Very Short Form of the Physical Self-Inventory adapted for individuals with intellectual disabilities (PSI-VSF-ID; Mañano et al., 2009). To assess global self-concept, the six-item graphical self-concept scale was used, along with two statements (Appendix A) related to global self-concept that were read to the participants.

After the statements were read, the participants circled which face on the six-item scale best depicted how they felt about themselves in relation to the statement (Mañano et al., 2009).

Collecting data during the fall semester allowed for 16 weeks of data collection, which occurred between August 31, 2011 and December 16, 2011. This study served as a pilot study due to its small sample size and limited duration. Through this study, preliminary data were obtained for future use in a grant proposal in which an ideal study could be performed. The data collected show the rate of change and fitness over time. Whether or not significant changes in 6MWD, RHR, BMI, and WC occur, this pilot study helps to predict the amount of time and the number of participants needed to observe greater changes in these health-related fitness variables as compared to the changes that occur during the “usual care” adapted physical education program in a larger and ideally more nationally representative sample of adolescents and young adults with intellectual disabilities. The preliminary data provides seminal insight for designing future trials aimed at assisting high school youth with intellectual disabilities adopt a healthy and more physically active lifestyle to assist them in their transition to an independent or semiindependent young adulthood.

### Participants

Eleven high school students with intellectual disabilities, aged 14 to 21 years, participated in this study. However, only nine of these students had useable data (see Table 1). These students came from the same special education class at a public high

Table 1: Demographics of All Nine Participants Who Completed the Study.

<b>Participant</b>	<b>Sex</b>	<b>Age</b>	<b>Ethnicity</b>	<b>IQ</b>	<b>Disability</b>
1	F	15	Pacific Islander	58	ID
2	F	19	Caucasian	52	ID
3	M	17	Caucasian	65	ID
4	F	16	Hispanic	44	ID, DS
5	M	17	Hispanic	64	ID
6	M	15	Caucasian	42	ID, DS
7	F	14	Hispanic	62	ID, Autism
8	M	20	Caucasian	58	ID, DS
9	F	17	Hispanic	45	ID

ID- Intellectual Disability

DS- Down syndrome

school in Salt Lake City, UT. The students' disabilities included Down syndrome and autism. The participants' IQ values were obtained from the classroom teacher to describe the subjects. The classroom teacher informed the researchers that all of the potential participants with Down syndrome *and* congenital heart defects had been successfully repaired by surgery. Nevertheless, information regarding the type of congenital heart defect, its severity, and the relative success of its surgical repair was obtained with a health history questionnaire, which was completed by a parent for each participant. The health history questionnaire helped to screen for which participants could safely participate in the running program phase of the study.

### Measures

#### Parental Permission and Assent Forms

Participants' parents completed a Parental Permission Form, which included information regarding background of the study, study procedure, risks, benefits, voluntary participation, confidentiality, person to contact, Institutional Review Board contact, cost and compensation to participants, and consent. Additionally, specific information regarding the child's condition and any medical issues that would be of concern was requested from the parents as explained above. Assent forms were also completed by all participants, which allowed us to obtain participant permission.

#### Six-Minute Walk Distance

The 6-minute walk test (6MWT) was used to assess cardiorespiratory fitness in this study. The 6-minute walk distance (6MWD) has a validity coefficient of  $r = 0.34$



( $p < 0.001$ ) (Morinder et al., 2009). Thus the 6MWD only accounts for 11.6% of the variance in  $\text{VO}_{2\text{max}}$ . However, the test is easy to administer, better tolerated, and reflects activities of daily living better than other walk tests (Morinder et al., 2009). The agreement in repeated 6MWDs over 4 days was assessed with a Bland-Altman plot (Morinder et al., 2009). The mean difference (95% limits of agreement) was 2.8 m (-65 m to 71 m). The 6MWT has somewhat limited validity and the variability in its repeatability is wide. Our use of eight weekly 6MWTs within each study phase may have, to some extent, helped to counter the wide variability in the repeatability of the 6MWT, as the serial assessments may have helped to provide a more stable estimate of how the 6MWD may have been affected by each study phase. Moreover, the 6MWT is increasingly used with individuals with intellectual disabilities because it requires much less physical exertion than alternatives such as the 12-minute walk test or 1-mile run (Elmahgoub et al., 2009).

Additionally, using the 6MWT allowed all participants to finish the test at the same time, thereby reducing the participants' waiting time. The simplicity of the test is well-suited for the population of adolescents and young adults with intellectual disabilities, who tend to struggle understanding multiple directions at once. When tested in obese adolescents, the BMI z-score was the best predictor of the variability in performances on the 6MWT as compared to other potential predictor variables such as weight, waist circumference, fat mass, fat free mass, body fat percentage, and lung function variables (Calders et al., 2007).

Standard 6MWT protocol was followed. For instance, the 6MWT was performed in a 30-meter hallway, which was marked every 3 meters and had orange cones placed at

the start and finish (American Thoracic Society, 2002). The team of three test administrators placed tick marks on each participant's 6MWT worksheet/report as they completed laps, and used a stopwatch to keep track of the time. One of the test administrators initially explained that the objective is to walk as far as possible for 6 minutes back and forth, but not to run or jog. One test administrator demonstrated and checked for understanding before beginning the test. The participants were told that they were allowed to stop and rest at any time, and could resume walking when they were ready. The protocol-prescribed encouragement phrases were given to the participants during every minute of the test, telling them how much time was left and saying "You are doing well" and "Keep up the good work." Once the 6 minutes were over, two of the three test administrators had the students stay where they were while the other test administrator counted the completed meters of the last lap.

### Resting Heart Rate

Resting heart rate (RHR) was the second measure taken each week. The test administrator put a POLAR heart rate monitor on each child at the beginning of the session. The students were seated for 5 minutes, after which the researcher recorded RHR for each child for 1 minute, had the child rest for 1 minute, recorded a second RHR for 1 minute, had the child rest for another minute, and recorded a third and final RHR for 1 minute. Using the average of the above three RHR measurements yielded an intraclass correlation coefficient of  $R_{ICC} = 0.90$  (Durant et al., 1993). The validity of this instrument when compared to a gold standard electrocardiogram determination of RHR ranges from  $r = 0.94$  to  $0.99$  (Treiber et al., 1989).

### Target Heart Rate Zone

Heart rate was monitored for a 5-minute period during activity for a total of six times during each study phase to determine the amount and proportion of activity time spent in the target heart rate zone. These six times were assessed once during weeks 4, 6, and 8 during each 8-week session. Target heart rate zone was determined based on recommendations by the Department of Health and Human Services (DHHS) that moderate-intensity physical activity is performed at 40-59% of the heart rate reserve (HRR) and that hard-intensity physical activity is performed at 60-84% of the HRR (DHHS, 2008). Heart rate reserve (HRR) is the difference between the age-predicted maximal HR ( $220 - \text{age}$ ) and the resting heart rate (RHR). The lower limit of the target heart rate zone was calculated as  $(\text{HRR} \times 0.40) + \text{RHR}$ , and the upper limit of the target heart rate zone was calculated as  $(\text{HRR} \times 0.84) + \text{RHR}$  (ACSM, 2006).

### Body Mass Index (BMI)

BMI is an index of overweight and obesity during childhood, adolescence, and adulthood. It is also easily determined from measuring height and weight (Cole, Bellizzi, Flegal, & Dietz, 2000). A wall-mounted stadiometer and right angle (manufactured by Perspective Enterprises in Portage, MI 49002 USA) were used to measure height at the end of inhalation (Hewyard & Wagner, 2004). Height was measured with shoes off, students' backs facing the wall, eyes looking straight ahead, heels together and touching the vertical board of the stadiometer, and arms hanging by the sides with palms facing the thighs. Heights were measured to the nearest tenth of a centimeter.

Weight was measured to the nearest tenth of a kilogram using a Healthometer Professional digital scale (Model 752KL, manufactured by Pelstar in Bridgeview, IL 60455 USA). Participants were instructed to remove their shoes and remain still while standing on the scale. BMI was calculated by dividing weight in kilograms by height in meters squared.

The validity of BMI as compared to a gold standard assessment of body fat percentage from a multicomponent model ranges from  $r = 0.70$  to  $0.82$  in youth (Lohman, 1992). The test-retest reliability of BMI has been reported to range from  $R_{ICC} = 0.98$  to  $0.99$  in individuals with intellectual disabilities (Waninge, van derWeide, Evenhuis, van Wijck, & van der Schans, 2009). Reliability is considered acceptable when the  $R_{ICC}$  value is  $> 0.80$  and the 95% confidence interval about the  $R_{ICC}$  is  $\leq 0.04$  (Waninge et al., 2009).

### Waist Circumference

Waist circumference was measured at the end of normal expiration at the narrowest part of the torso, between the ribs and iliac crest (Heyward & Wagner, 2004). Waist circumference can be used as an indicator of health risk due to its measurement of abdominal adiposity. The measure was taken twice for each participant each testing session and recorded in centimeters, and required the use of a flexible yet inelastic tape measure. A Gulick measuring tape made of fiberglass that contains a self-winding case and a calibrated tension device was used to measure waist circumference (Model M-22 C, manufactured by Creative Health Products in Plymouth, MI 48170 USA).

The validity of waist circumference as compared to a gold standard assessment of visceral adipose tissue volume from magnetic resonance imaging has been documented as ranging from  $r = 0.82$  to  $0.87$  ( $p < 0.001$ ) in pubertal children (Bosy-Westphal et al., 2010). The test-retest reliability of waist circumference measurements has been reported to range from  $R_{ICC} = 0.95$  to  $0.97$  in individuals with intellectual disabilities (Waninge et al., 2009).

### Self-concept

Self-concept was assessed directly before and after each Friday exercise bout in the control phase and the intervention phase. The validity of the Very Short Form of the Physical Self-Inventory adapted for individuals with intellectual disabilities (PSI-VSF-ID) is documented by a confirmatory factor analysis-derived loading factor ( $\lambda$ ) of  $0.745$  and uniqueness ( $\delta$ ) of value  $0.455$ ,  $p < 0.001$  for the first global self-concept item and by a  $\lambda = 0.620$  and  $\delta = 0.284$ ,  $p < 0.001$  for the second global self-concept item (Mañano et al., 2009). These loading factors and uniqueness values are not ideal. However, the above graphical version of the youths' response scale performed better than the traditional Likert version, which yielded  $\lambda = 0.660$  and  $\delta = 0.436$ ,  $p < 0.001$  for the first global self-concept item and  $\lambda = 0.545$  and  $\delta = 0.297$ ,  $p < 0.001$  for the second global self-concept item. In addition, these global self-concept items were validated in a sample of 342 adolescents with intellectual disabilities. Obviously, it is challenging to accurately measure psychological variables in youth with intellectual disabilities. The test-retest reliability for the graphical version of PSI-VSF-ID was  $R_{ICC} = 0.80$  ( $p < 0.01$ ) (Mañano et al., 2009). After the two global self-concept items, "I like myself" and "I want to stay as

I am” were read to the participants one at a time, they circled which face best depicted how they felt regarding the statement that was just read.

### Procedures

After Institutional Review Board (IRB) approval from the University of Utah and approval from Salt Lake City School District were obtained, Parental Permission Forms were given to the classroom teacher to dispense to her students’ parents. These signed forms were mailed to the faculty sponsor in self-addressed, stamped envelopes.

Additionally, the principal investigator read the assent forms to the students and obtained their signatures. Once permission was obtained, health history questionnaires were completed by the parents of all possible participants to ensure that the students could safely participate in the running phase of the program. The study began on the second week of school for the local high school in the Fall of 2011. The researcher and one research assistant went to the school three times per week, on Monday, Wednesday and Friday, for a period of one hour. The second session of the week always consisted of testing of the health-related fitness variables of the participants during each 8-week phase of the study. The third session of the week always consisted of testing self-concept in the participants during both the control and intervention phases.

During the control phase the lessons began with obstacle courses. Mondays were reserved for learning object control skills and Fridays were used to play games that incorporated the skills learned on Mondays. The fitness testing took up the entire allotted lesson time on Wednesdays. The object control skills that were presented in the control phase were catching, throwing, kicking, striking, underhand rolling, and bouncing.

During the running program there was a 5-minute warm-up of walking to the basement hallway from the classroom, 5 minutes of dynamic stretching activities (high knees, butt kicks, etc.) and running tips, 10 minutes of three laps of running/walking to be marked on the Achilles Kids Running Log Page (three basement hallway laps were equivalent to a quarter of a mile), 20 minutes of playing games incorporating running such as tag, 10 minutes of relays, 5 minutes of static stretching, and a 5-minute walk back to the classroom from the basement as a cool-down. Avoidance in the form of running tag activities and social interaction in the form of running relays are generally effective ways to get kids excited about running (Hill, 2000). A hallway that did not disrupt other students was located and reserved for use in this study. On testing days, the order of the schedule remained the same, but less time was spent on each task. Upon returning to class, the research team helped the participants update their Achilles Kids Map, log their miles individually, and see their progress.

### Statistical Analysis

After obtaining 16 total data points for each subject, the split-middle technique was used to statistically analyze the data. In this study, the number of data points in each study phase (e.g., eight) provided power rather than the number of subjects. Each child served as his or her own control. Using the split-middle technique allowed the researchers to examine the rate of fitness change over time for a single individual. This technique is designed to reveal a linear trend in the data, and allowed for characterization of present performance in the control phase and prediction of future performance in the experimental phase. Use of the split-middle technique permits examination of the trend

or slope within the study's two phases, as well as comparison of slopes across the phases (Cooke & Campbell, 1979; Kazdin, 1982).

The data were first graphically plotted and a celeration line was constructed. The two phases were analyzed separately. Initially, the first phase was divided into fourths. The median rate of performance (typically between the week four and five assessment in an 8-week study phase) was then determined for the first and second halves of the phase. Once median values were selected within each half, a vertical and horizontal line intersected. The next step was to find the slope by drawing a line connecting the points of intersection between the two halves. Lastly, the researcher determined whether the resulting line "split" the data so that 50% of the data points fell on or above the line and 50% of the data points fell on or below the line, adjusting the line accordingly until the line did in fact split the data points down the middle.

Statistical significance of change across phases was evaluated once the celeration lines were calculated. The null hypothesis was that there is no change in performance between study phases. It was assumed that the probability of a data point during the intervention phase falling above the projected celeration line of baseline is 50%, or  $p = 0.5$ . Using a binomial test, the researcher determined if the number of data points above the projected slope in the intervention phase was of a sufficiently low probability to reject the null hypothesis. A  $p$ -value of  $< 0.05$  was needed to show statistical significance for each individual.

To determine the interactive effects of study treatment type (control vs. experimental running phase), treatment duration (first 4 weeks vs. second 4 weeks), and acute exercise (pre vs. postexercise) on each of the two global self-concept items, we



used a 2 x 2 x 2 repeated measures analysis of variance (RM ANOVA). Due to the high likelihood of student absences and missing values within each of the planned eight assessments of pre and postexercise global self-concept, the decision was made to use the on-study average of the pre-exercise global self-concept scores and the on-study average of the postexercise global self-concept scores during the first and the last four weeks of each study phase. Using the on-study average values in the first four and the last four weeks of each study phase obviates the need to use imputed values for missing data. All of the global self-concept data were assessed for normality, and all of the assumptions of RM ANOVA were assessed before testing the hypothesized interactions of study treatment type by treatment duration by acute exercise on the global self-concept items.

## CHAPTER 4

### RESULTS

The results are initially presented by participant number and fitness outcome (Figures 1-36). Experimental phase-related differences in the fitness outcomes are then summarized by participant (Table 2). The average amount of time spent in the THRZ during the sampled exercise bouts is presented by experimental phase (Table 3). Finally, the interactive effects of intervention phase and acute exercise on global self-concept are presented by item (Figure 37).

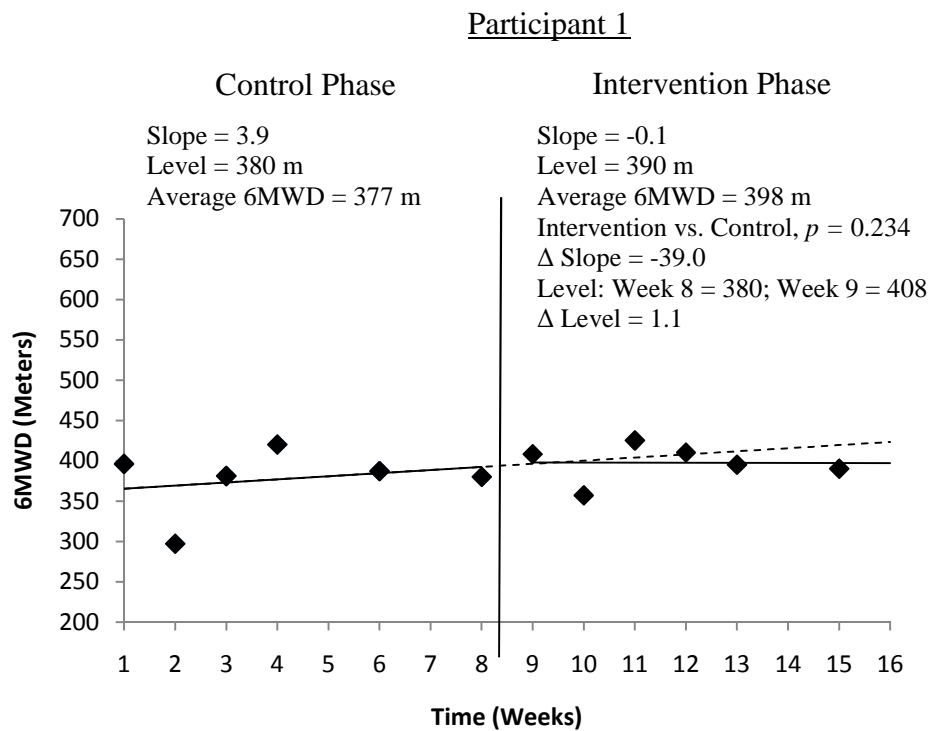


Figure 1: Participant 1 showed no significant difference between the control and intervention phases ( $p = 0.234$ ) in 6MWD. Participant 1 was a 15-year-old female. Her 6MWD slope was 3.9 in the control phase, but decreased to -0.1 in the intervention phase. However, her average 6MWD increased by 21 meters in the intervention phase. There were no significant differences between the control and intervention phases in 6MWD.

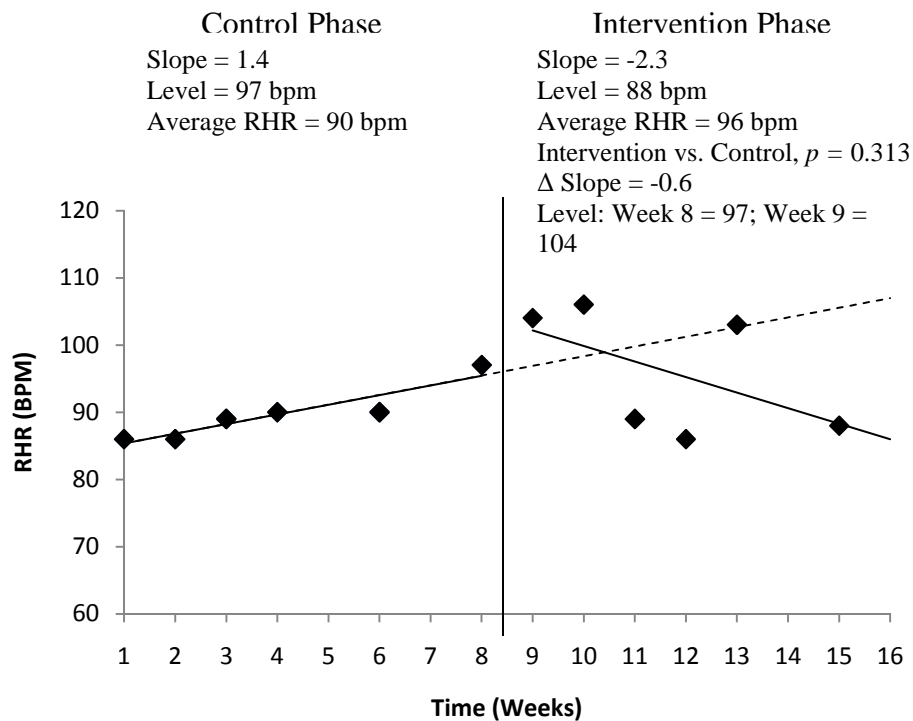


Figure 2: Participant 1 showed no significant difference between the control and intervention phases ( $p = 0.313$ ) in RHR. Participant 1 had a RHR slope of 1.4 in the control phase, which decreased to -2.3 in the intervention phase. However, her average RHR was 6 bpm higher in the intervention phase. There were no significant changes between the two phases.

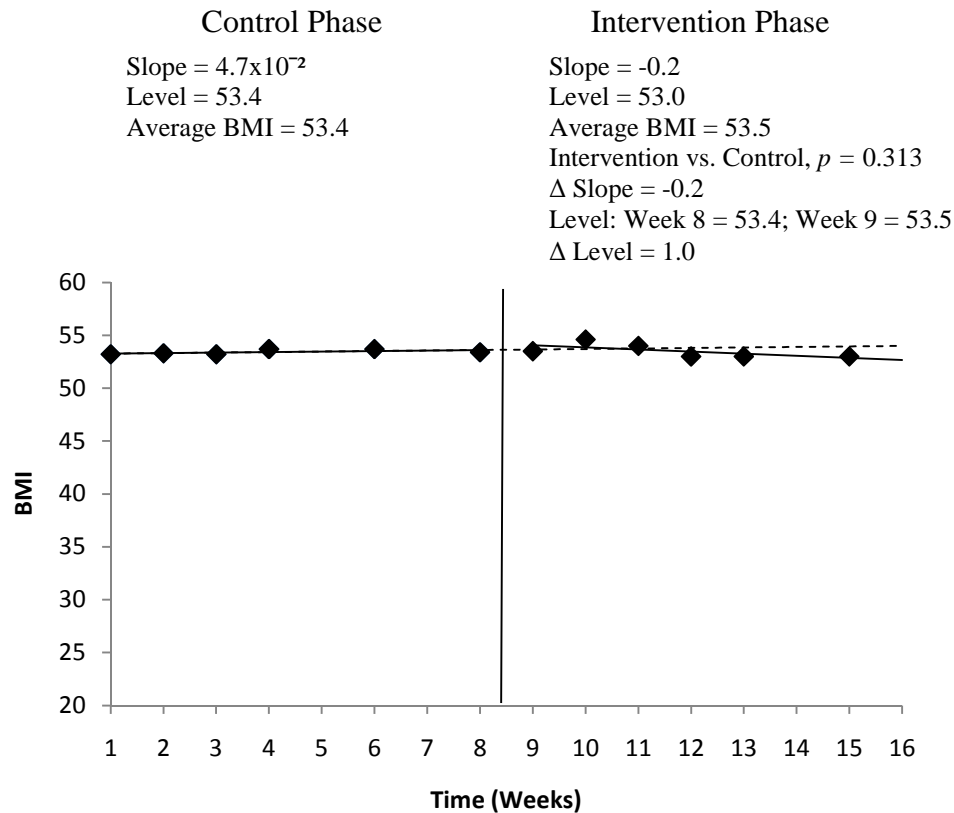


Figure 3: Participant 1 showed no significant difference between the control and intervention phases ( $p = 0.313$ ) in BMI. Participant 1 had a minimal slope of  $4.7 \times 10^{-2}$  in the control phase, which decreased to -0.2 in the intervention phase. Her average BMI in the control phase was 53.4, followed by an average BMI of 53.5 in the intervention phase. There were no significant changes between the two phases.

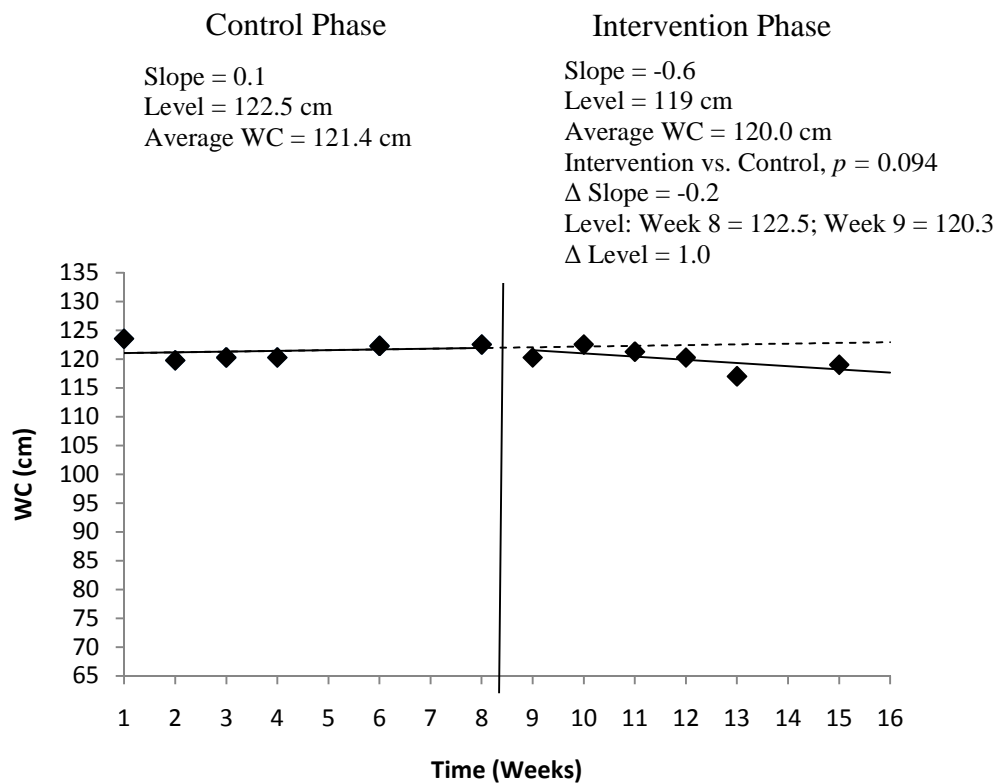


Figure 4: Participant 1 showed no significant difference between the control and intervention phases ( $p = 0.094$ ) in WC. Participant 1 had a slightly positive WC slope of 0.1 in the control phase, followed by a negative slope of -0.6. Her average WC decreased from 122.5 cm to 120.0 cm from the control to the intervention phase. Due to two absences during the intervention phase, significant differences were not found between the two phases. With more data points in the intervention phase, significance would have been found with the trend shown in Figure 4.

### Participant 2

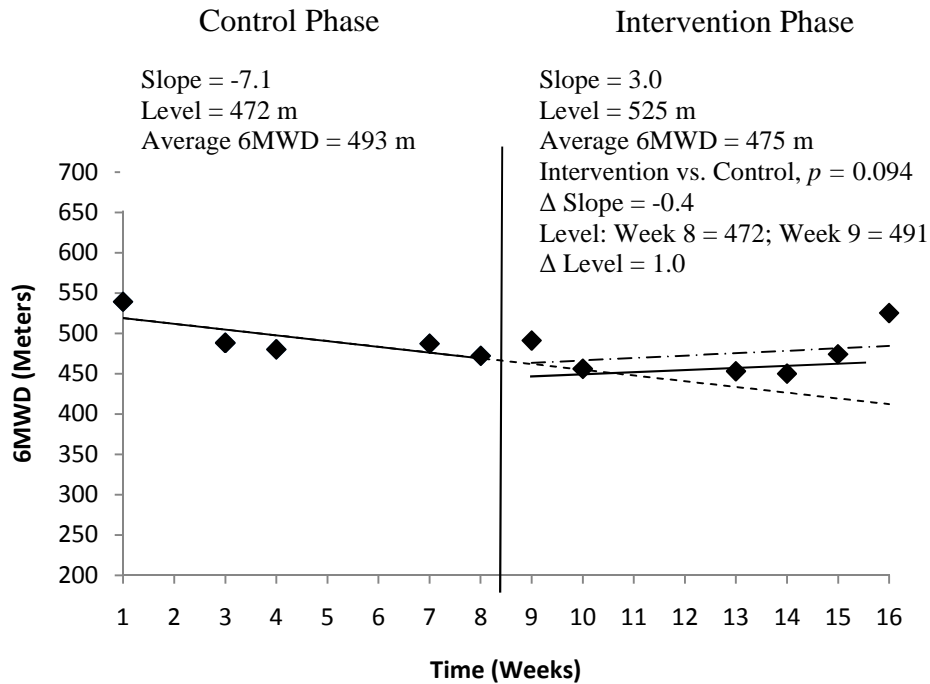


Figure 5: Participant 2 showed no significant difference between the control and intervention phases ( $p = 0.094$ ) in 6MWD. The solid line in the intervention phase is the adjusted celeration line and the long dash dotted broken line in the intervention phase is the actual celeration line. The line with small dashes in the intervention phase is the continuation of the control phase celeration line. Participant 2 was a 19-year-old female. She had a negative 6MWD slope of -7.1 in the control phase, followed by a positive slope of 3.0 in the intervention phase. Her average 6MWD was 493 m in the control phase and 475 m in the intervention phase. Due to two absences in the intervention phase, significance was not found even though most of her data points are above the celeration line continued from the control phase.

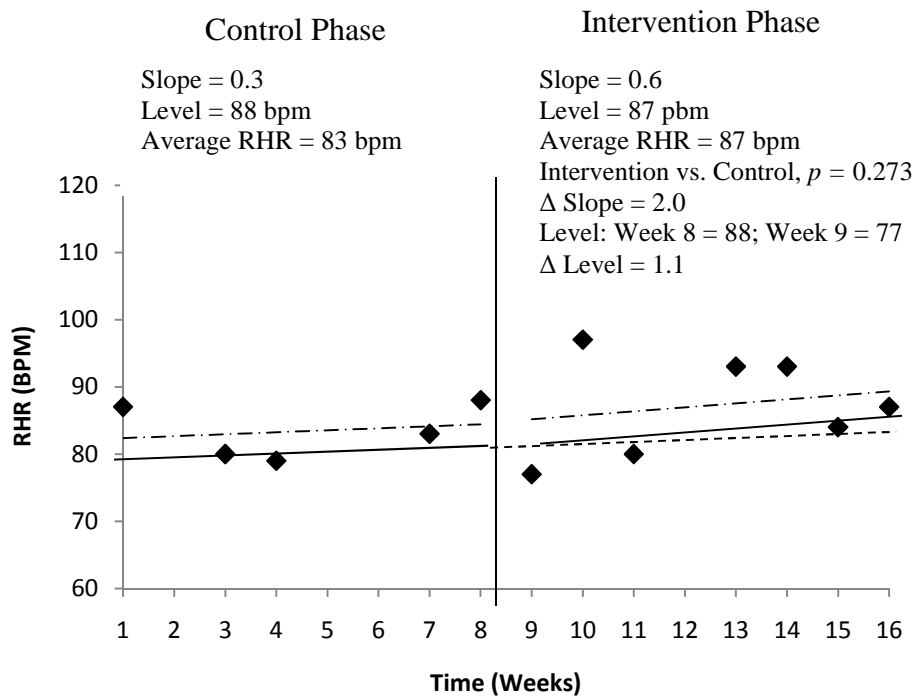


Figure 6: Participant 2 showed no significant difference between the control and intervention phases ( $p = 0.273$ ) in RHR. The solid line in the intervention phase is the adjusted acceleration line and the long dash dotted broken line in the intervention phase is the actual acceleration line. The line with small dashes in the intervention phase is the continuation of the control phase acceleration line. Participant 2 had a RHR slope of 0.3 in the control phase, followed by a slope of 0.6 in the intervention phase. Her average RHR was 4 bpm higher in the intervention phase than the control phase. No significant difference was found between the two phases.



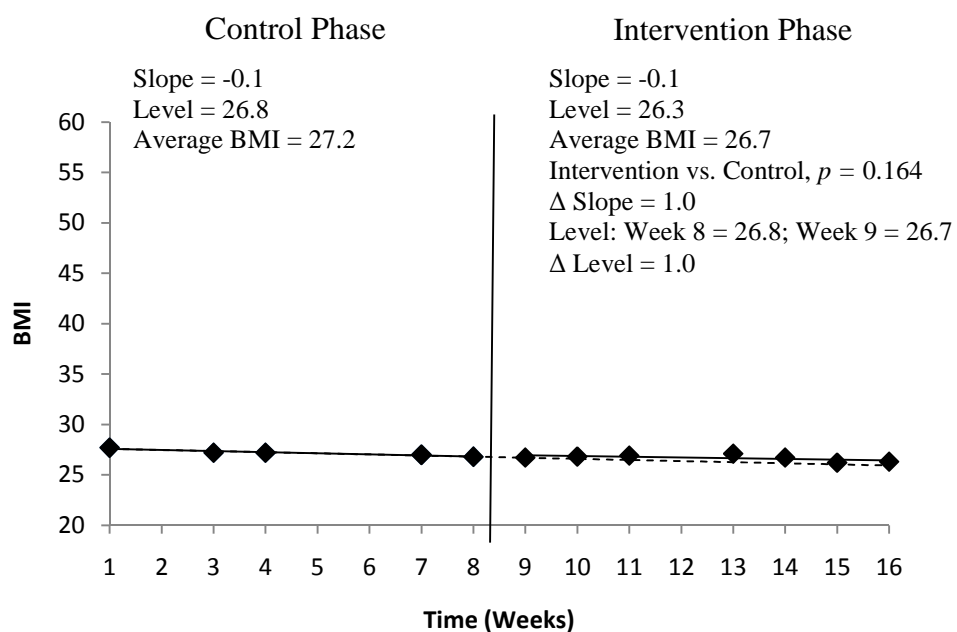


Figure 7: Participant 2 showed no significant difference between the control and intervention phases ( $p = 0.164$ ) in BMI. Participant 2 had a BMI slope of -0.1 in both the control and intervention phases. Her average BMI dropped from 27.2 to 26.7 from the control to the intervention phase. No significant difference was found between the two phases.

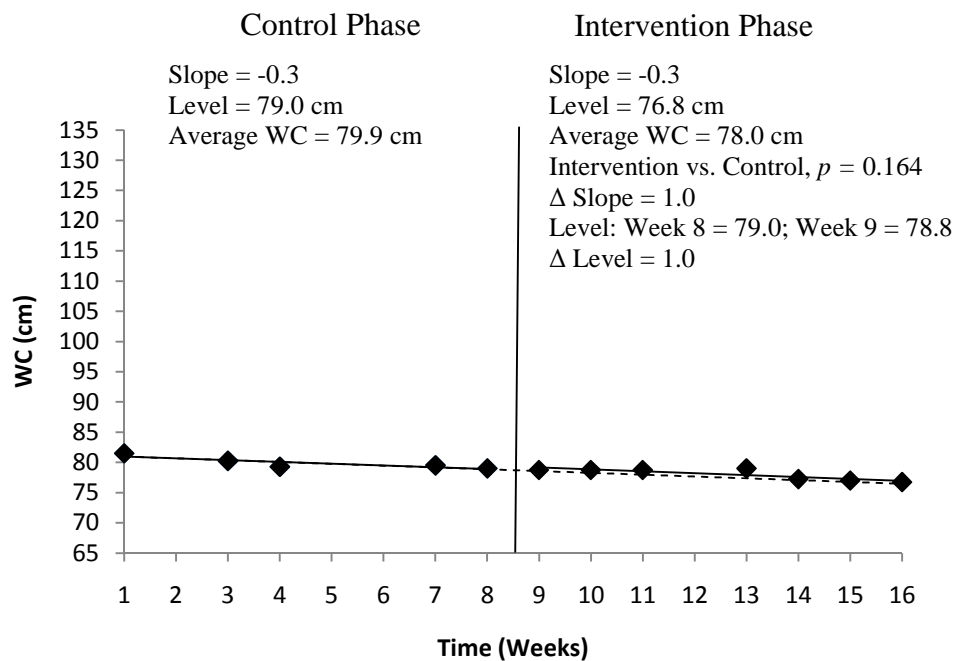


Figure 8: Participant 2 showed no significant difference between the control and intervention phases ( $p = 0.164$ ) in WC. Participant 2 had a WC slope of -0.3 in both phases, and a 1.9 cm decrease in average WC from the control phase to the intervention phase. No significant difference was found between the two phases.

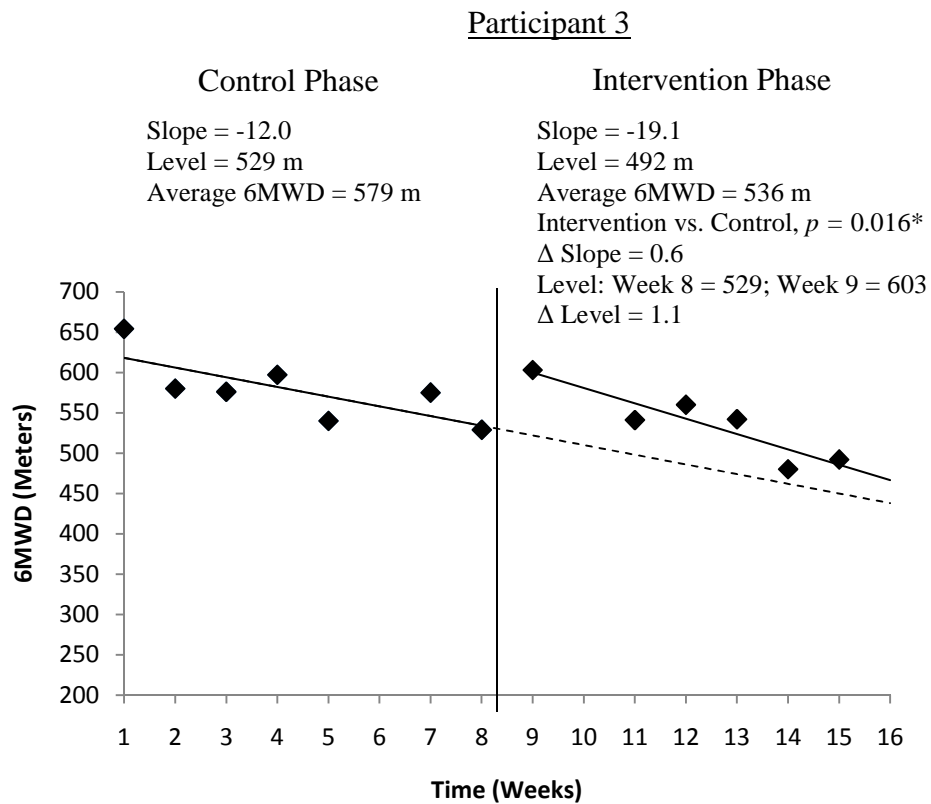


Figure 9: Participant 3 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.016$ ) in 6MWD detected between the two phases. Participant 3 was a 17-year-old male. He had a 6MWD slope of -12.0 in the control phase, followed by a slope of -19.1 in the intervention phase. The average 6MWD was 43 m lower in the intervention phase, but significance was found in the hypothesized direction due to the fact that the celeration line had such a steep negative slope. The last two data points in the intervention phase were likely quite low due to the fact that the participant suffered from a concussion prior to those two testing days, and was unable to walk quickly because of resulting dizziness.

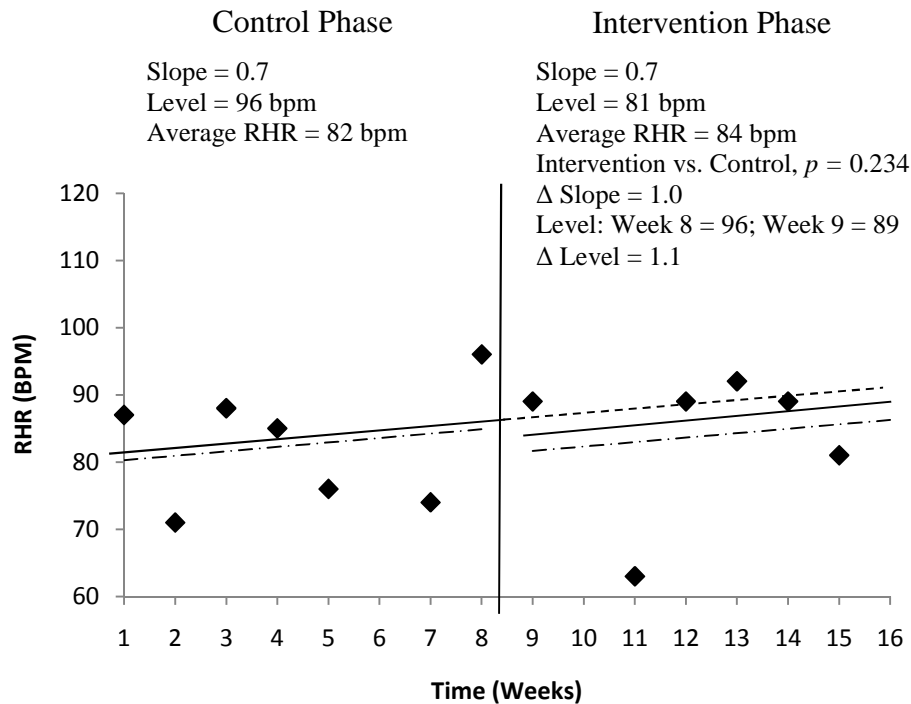


Figure 10: Participant 3 showed no significant difference between the control and intervention phases ( $p = 0.234$ ) in RHR. The solid line in both phases is the adjusted celeration line and the long dash dotted broken line in both phases is the actual celeration line. The line with small dashes in the intervention phase is the continuation of the control phase celeration line. Participant 3 had a RHR slope of 0.7 in both the control and intervention phases. His average RHR was 2 bpm higher in the intervention phase than the control phase. No significant difference was found between the two phases.

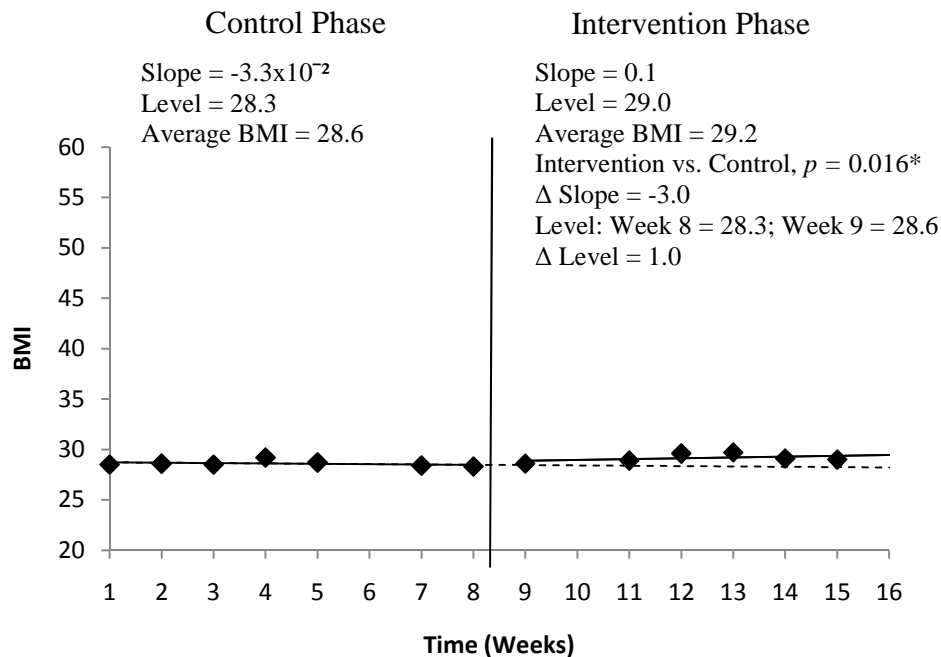


Figure 11: Participant 3 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.016$ ) in BMI detected between the two phases. Participant 3 had a slightly negative slope of  $-3.3 \times 10^{-2}$  in the control phase, and a slightly positive slope of 0.1 in the intervention phase. The average BMI was 28.6 in the control phase versus 29.2 in the intervention phase. Significance was found between the two phases, although it was opposite of the hypothesized direction.

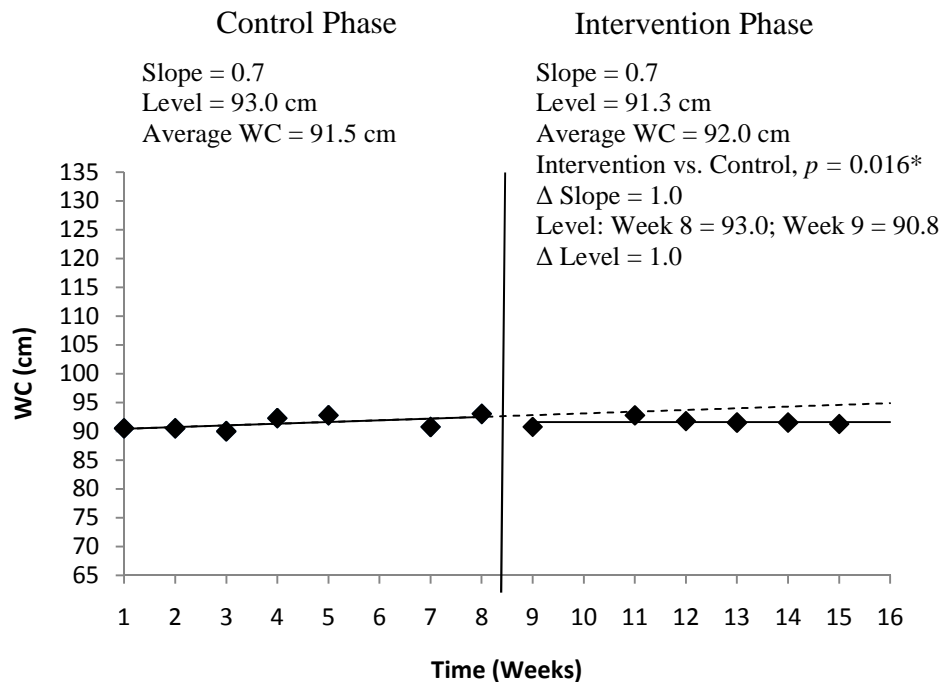


Figure 12: Participant 3 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.016$ ) in WC detected between the two phases. Participant 3 had a WC slope of 0.7 in both the control and intervention phases. His average WC increased by 0.5 cm from the control to the intervention phase. Despite this slight increase in average WC, there was a significant difference between phases based on number of intervention data points below the celeration line continued from the control phase.

### Participant 4

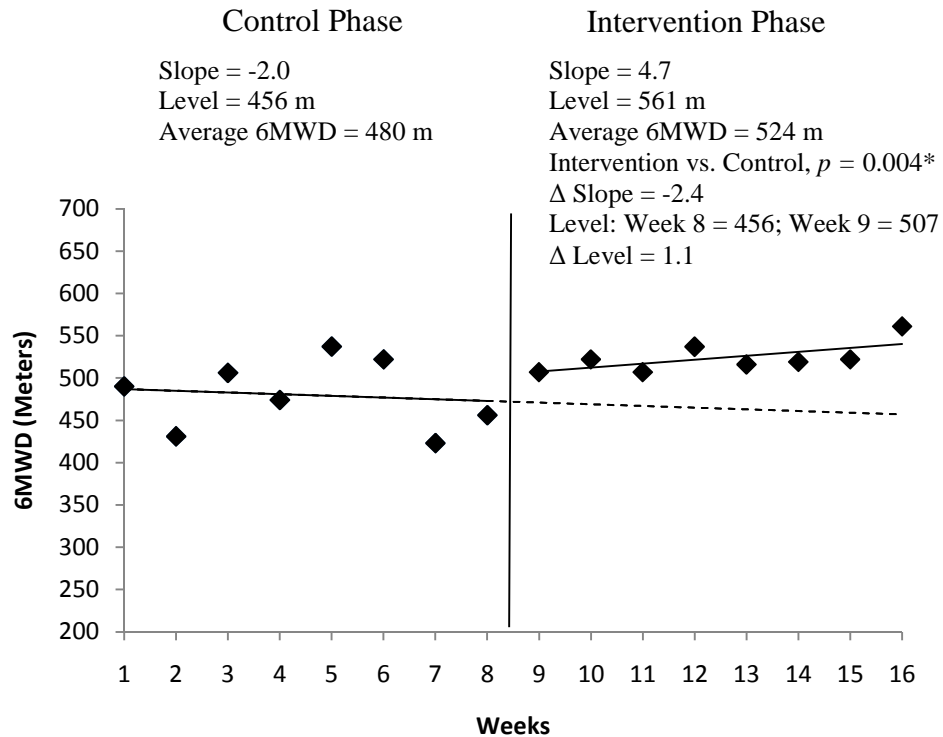


Figure 13: Participant 4 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.004$ ) in 6MWD detected between the two phases. Participant 4 was a 16-year-old female. Her 6MWD slope was -2.0 for the control phase, followed by a slope of 4.7 for the intervention phase. Her average 6MWD was 44 m higher in the intervention phase than the control phase. She showed a significant increase in the intervention phase as compared to the control phase.

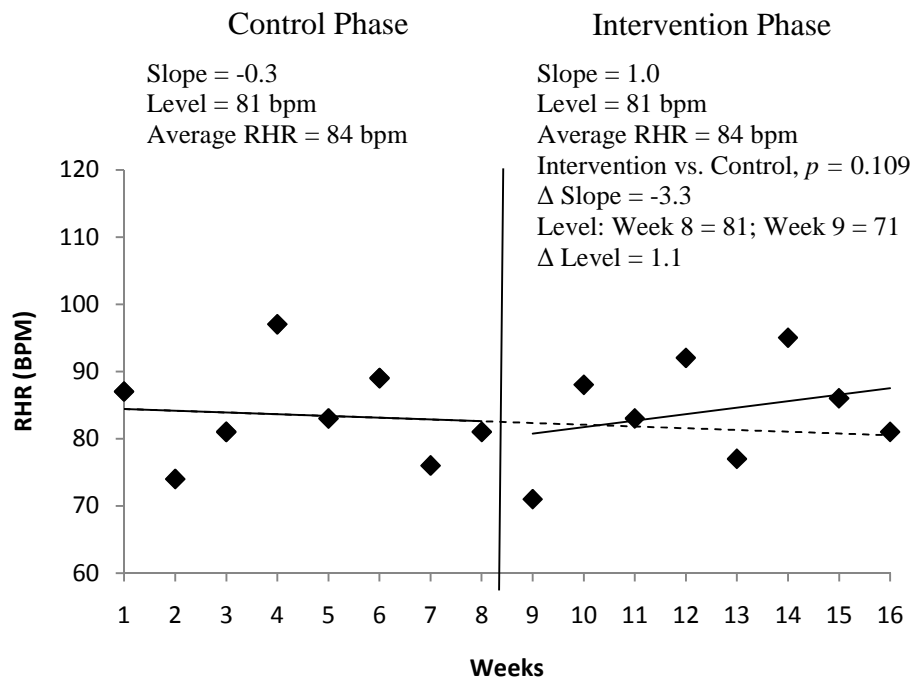


Figure 14: Participant 4 showed no significant difference between the control and intervention phases ( $p = 0.109$ ) in RHR. Participant 4 had a RHR slope of -0.3 in the control phase, and a slope of 1.0 in the intervention phase. Both phases had an average RHR of 84 bpm, and there was no significant difference between the two phases.



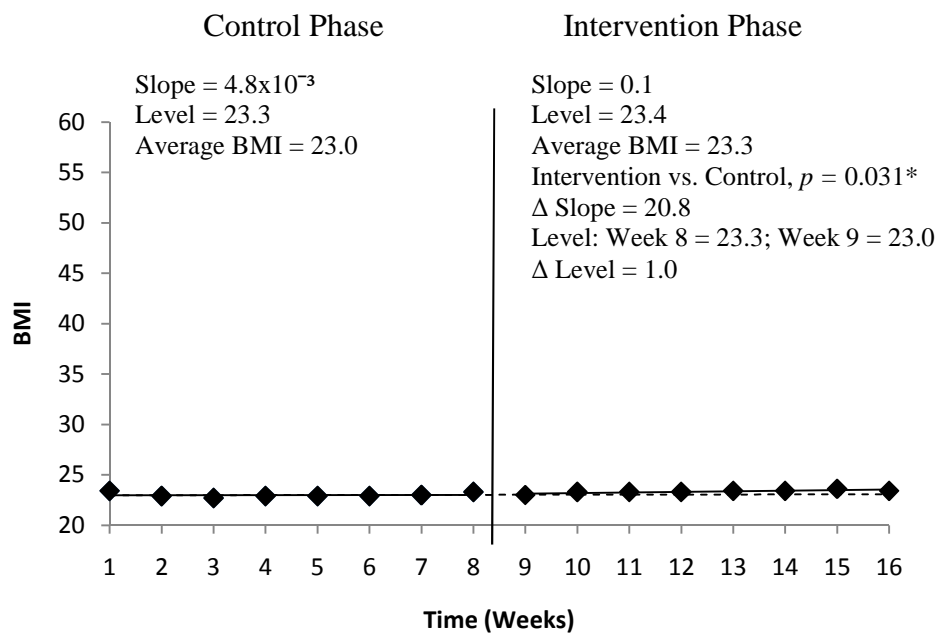


Figure 15: Participant 4 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.031$ ) in BMI detected between the two phases. Participant 4 had a slightly positive BMI slope of  $4.8 \times 10^{-3}$  in the control phase, and a slightly positive slope of 0.1 in the intervention phase. The average BMI increased by 0.3 from the control to intervention phase. There was a significant change in BMI between the two phases, which occurred opposite the hypothesized direction.

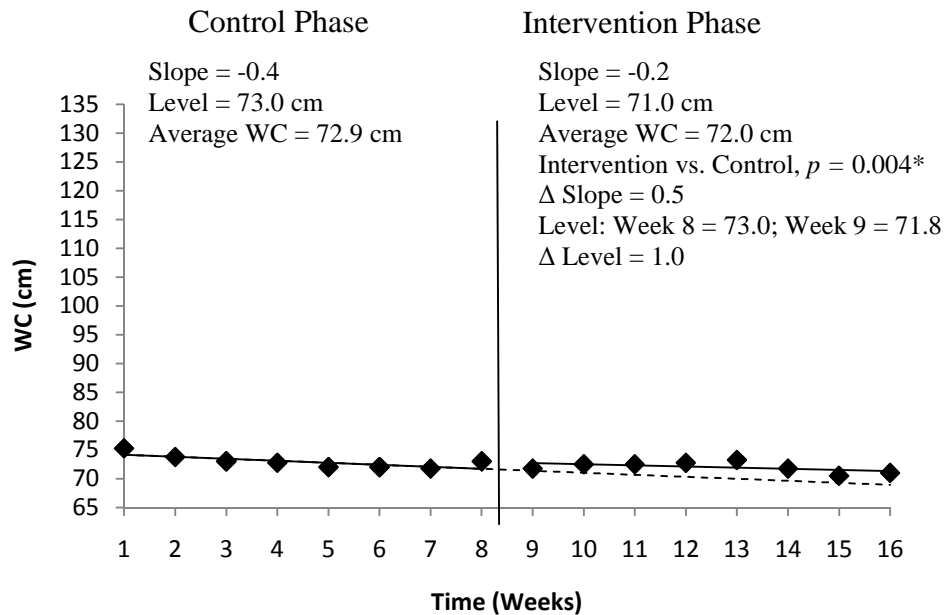


Figure 16: Participant 4 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.004$ ) in WC detected between the two phases. Participant 4 had slightly negative WC slopes of -0.4 and -0.2 in the control and intervention phases, respectively. The average WC decreased by 0.9 cm from the control to intervention phase. However, there was a significant difference between the two phases in the non-hypothesized direction.

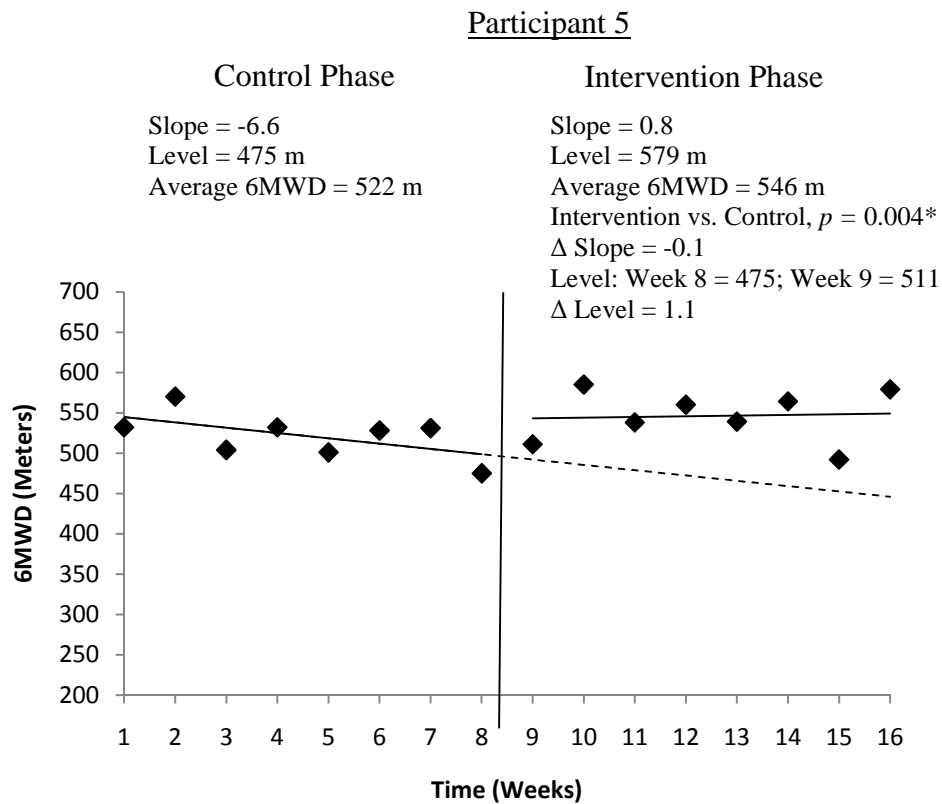


Figure 17: Participant 5 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.004$ ) in 6MWD detected between the two phases. Participant 5 was a 17-year-old male. He had a negative 6MWD slope of -6.6 in the control phase, and a slightly positive slope of 0.8 in the intervention phase. His average 6MWD increased by 24 m from the control to intervention phase. A significant difference was detected between the two phases, in the hypothesized direction.

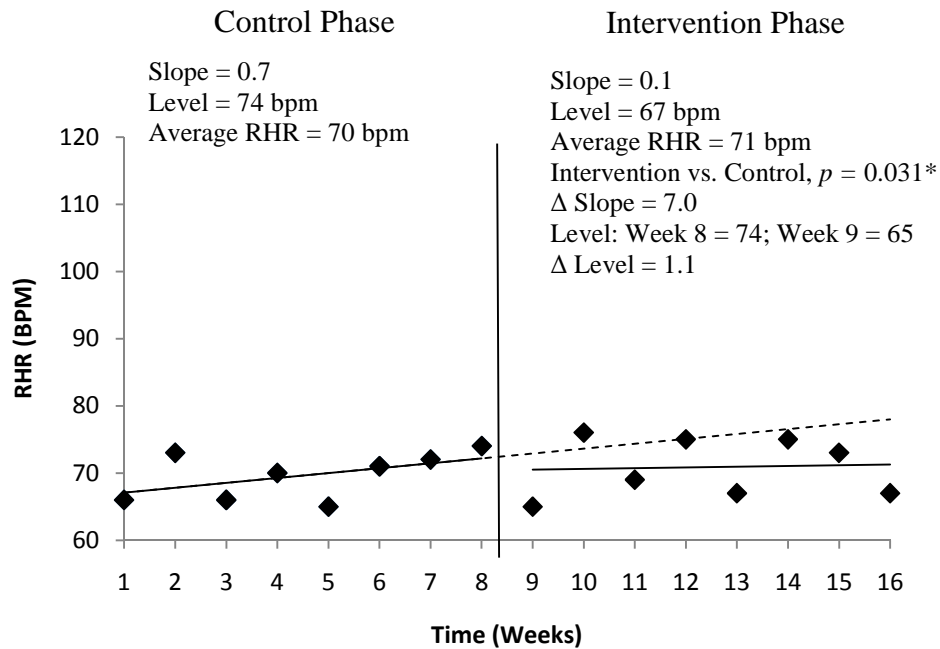


Figure 18: Participant 5 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.031$ ) in RHR detected between the two phases. Participant 5 had a RHR slope of 0.7 in the control phase and 0.1 in the intervention phase. His average RHR increased by 1 bpm from the control to intervention phase. There was a significant difference between the two phases, which occurred in the hypothesized direction.

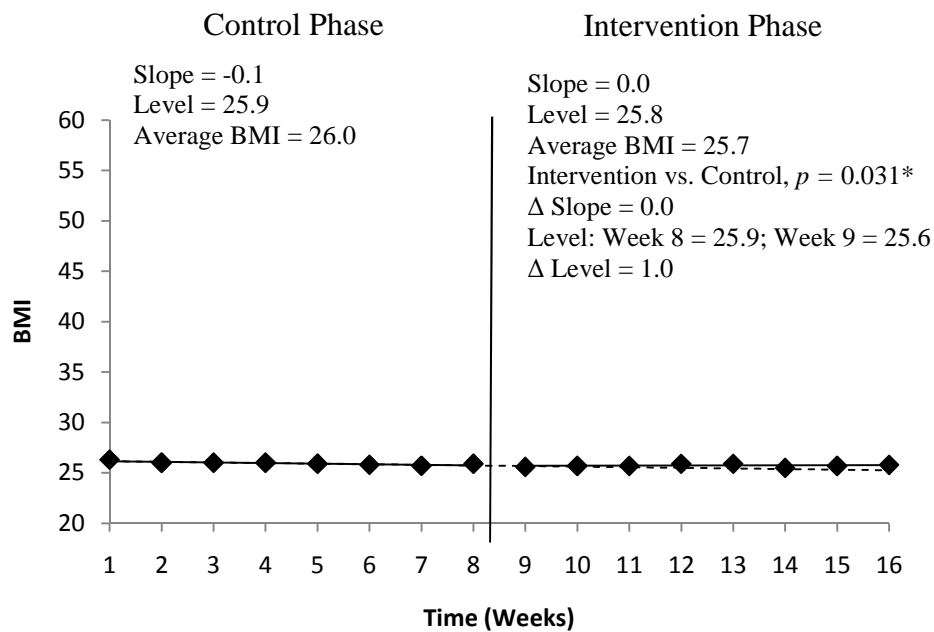


Figure 19: Participant 5 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.031$ ) in BMI detected between the two phases. Participant 5 had a slope of -0.1 in the control phase and 0.0 in the intervention phase. His average BMI decreased by 0.3 from the control to intervention phase. However, there was a significant difference between the two phases in the non-hypothesized direction.

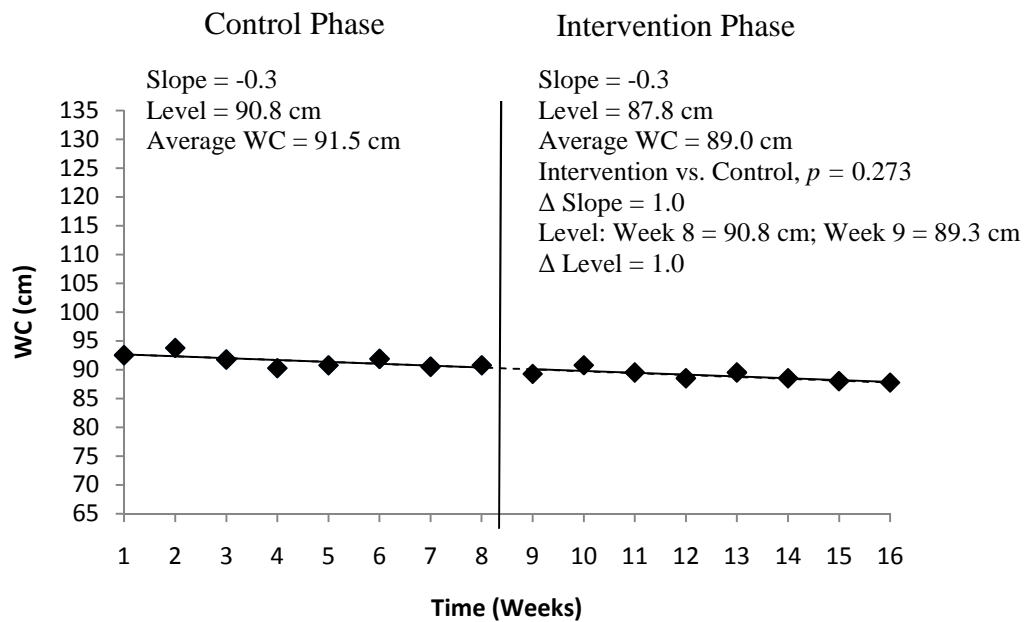


Figure 20: Participant 5 showed no significant difference between the control and intervention phases ( $p = 0.273$ ) in WC. Participant 5 had a WC slope of -0.3 in both the control and intervention phases. His average WC decreased by 2.5 cm from the control to intervention phase. Despite the decrease in WC, there was no significant difference between the two phases.

### Participant 6

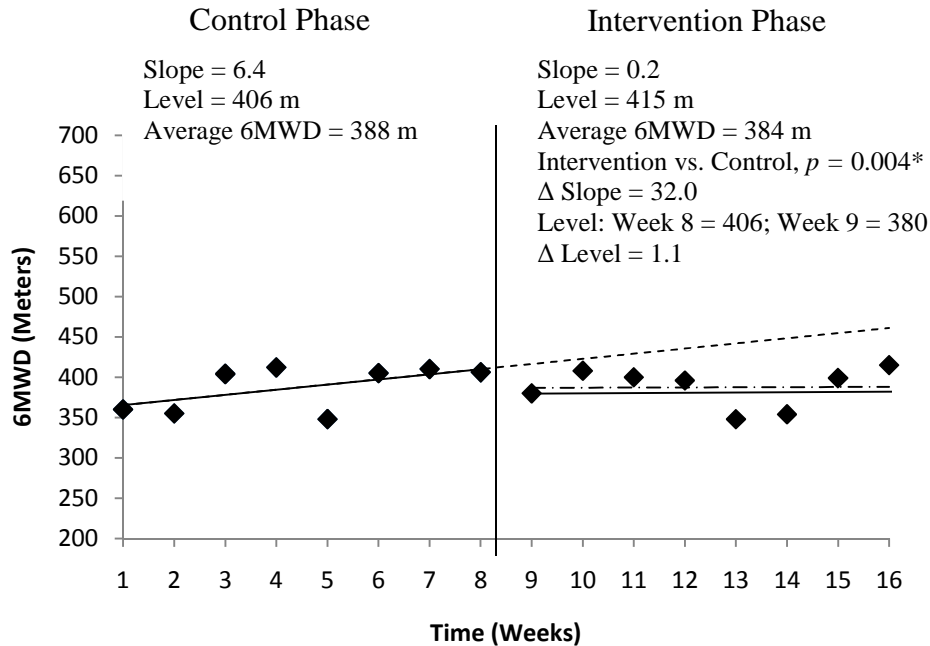


Figure 21: Participant 6 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.004$ ) in 6MWD detected between the two phases. The solid line in the intervention phase is the adjusted celeration line and the long dash dotted broken line in the intervention phase is the actual celeration line. The line with small dashes in the intervention phase is the continuation of the control phase celeration line. Participant 6 was a 15-year-old male. His 6MWD slope was 6.4 in the control phase and 0.2 in the intervention phase. The average 6MWD decreased by 4 m from the control to intervention phase. A significant difference was detected between the two phases, but it was in the non-hypothesized direction.

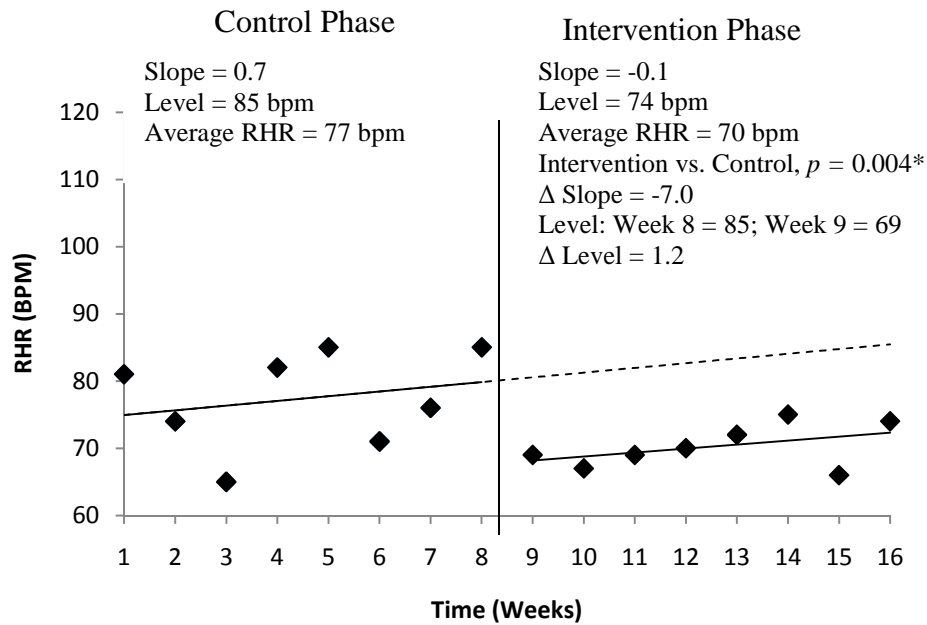


Figure 22: Participant 6 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.004$ ) in RHR detected between the two phases. Participant 6 had a slope of 0.7 in the control phase and -0.1 in the intervention phase. The average RHR decreased by 7 bpm from the control to intervention phase. A significant difference in the hypothesized direction was found between the two phases.



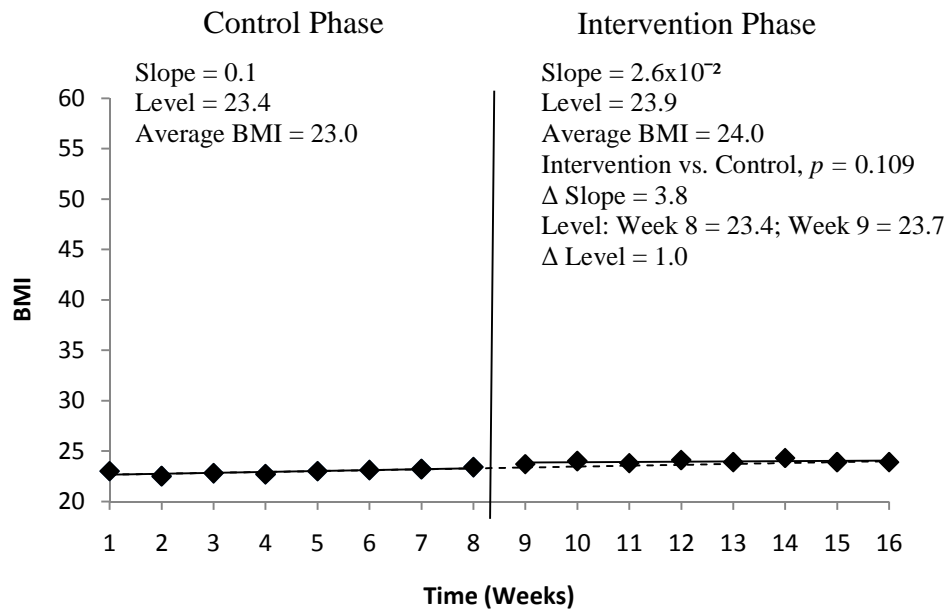


Figure 23: Participant 6 showed no significant difference between the control and intervention phases ( $p = 0.109$ ) in BMI. Participant 6 had a slope of 0.1 in the control phase and  $2.6 \times 10^{-2}$  in the intervention phase. His average BMI increased by 1.0 from the control to intervention phase. There was no significant difference detected between the two phases.

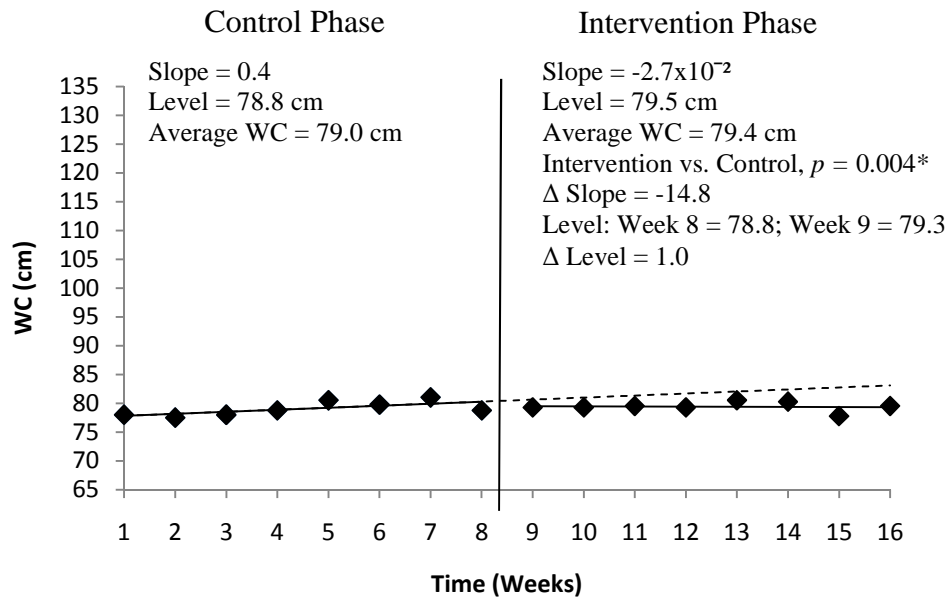


Figure 24: Participant 6 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.004$ ) in WC detected between the two phases. Participant 6 had a WC slope of 0.4 in the control phase and  $-2.7 \times 10^{-2}$  in the intervention phase. His average WC increased by 0.4 cm from the control to intervention phase. A significant difference in the hypothesized direction was detected between the two phases.

### Participant 7

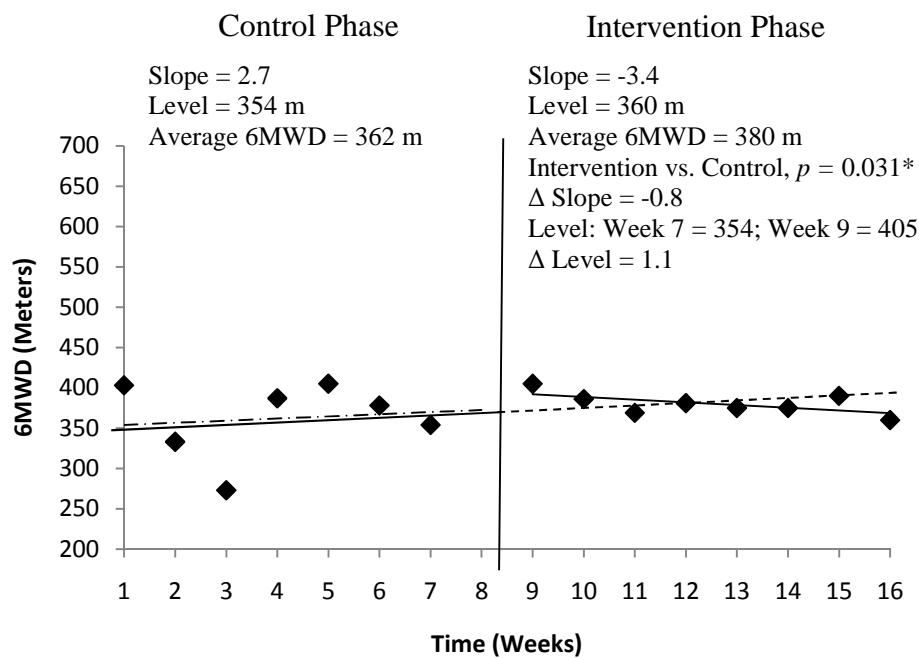


Figure 25: Participant 7 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.031$ ) in 6MWD detected between the two phases. The solid line in the control phase is the adjusted celeration line and the broken line in the control phase is the actual celeration line. Participant 7 was a 14-year-old female. Her 6MWD slope was 2.7 in the control phase and -3.4 in the intervention phase. Her average 6MWD increased by 18 m from the control to intervention phase, but significant differences were found between the two phases in the non-hypothesized direction.

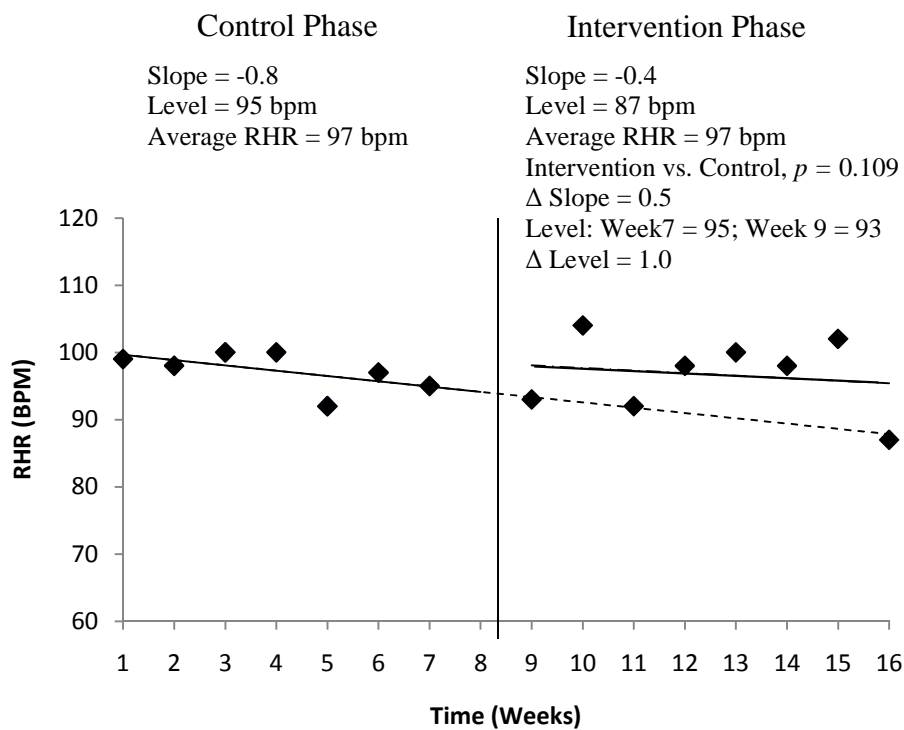


Figure 26: Participant 7 showed no significant difference between the control and intervention phases ( $p = 0.109$ ) in RHR. The solid line in the intervention phase is the adjusted celeration line and the long dash dotted broken line in the intervention phase is the actual celeration line. The line with small dashes in the intervention phase is the continuation of the control phase celeration line. Participant 7 had a RHR slope of -0.8 in the control phase and -0.4 in the intervention phase. His average RHR remained the same in both phases. No significant difference was detected between the two phases.

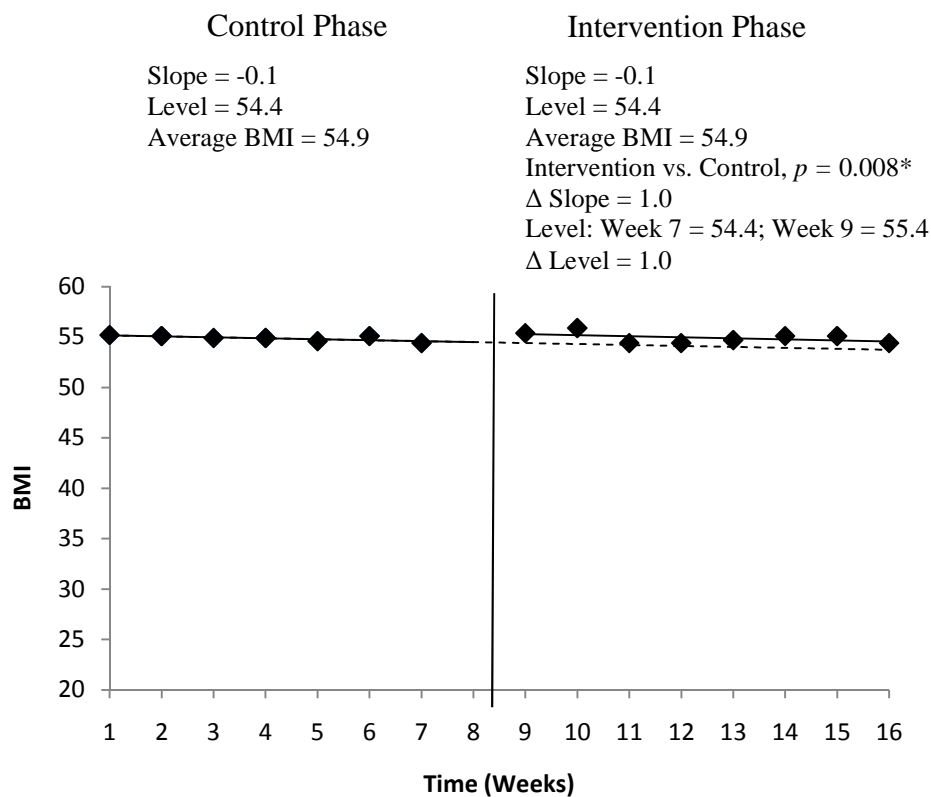


Figure 27: Participant 7 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.008$ ) in BMI detected between the two phases. Participant 7 had a BMI slope of -0.1 in both the control and intervention phases. Her average BMI remained constant for both of the phases. Significant differences were detected between the two phases, but occurred in the non-hypothesized direction.

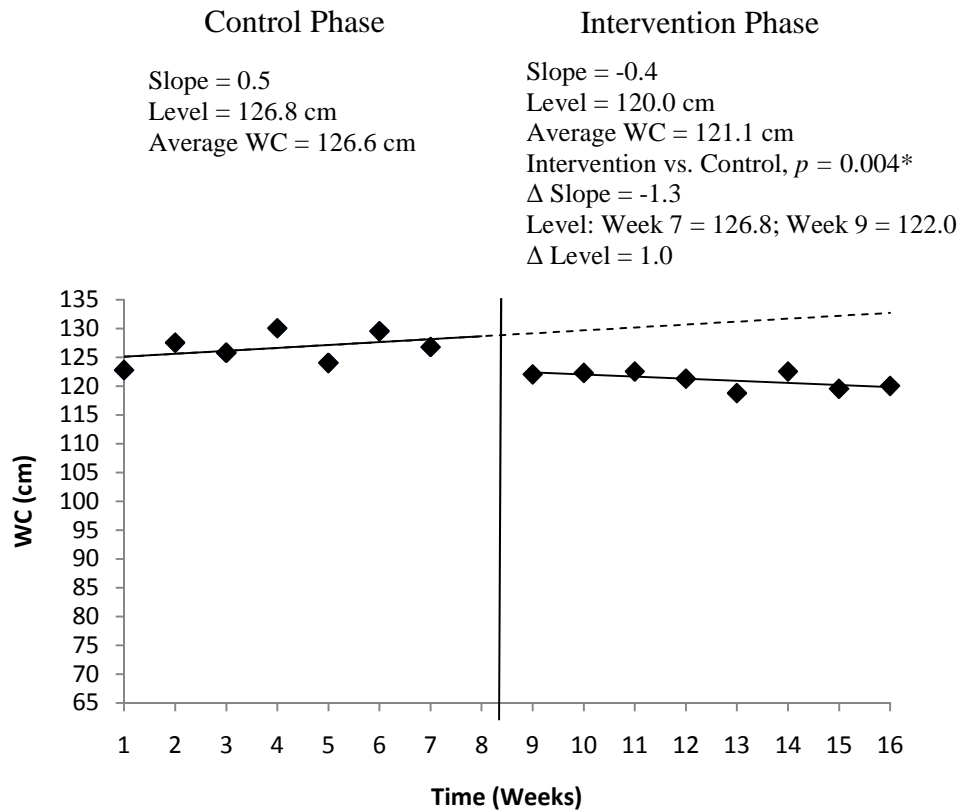


Figure 28: Participant 7 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.004$ ) in WC detected between the two phases. Participant 7 had a slope of 0.5 in the control phase and -0.4 in the intervention phase. Her average WC decreased by 5.5 cm from the control to intervention phase. A significant difference in the hypothesized direction was detected between the two phases.

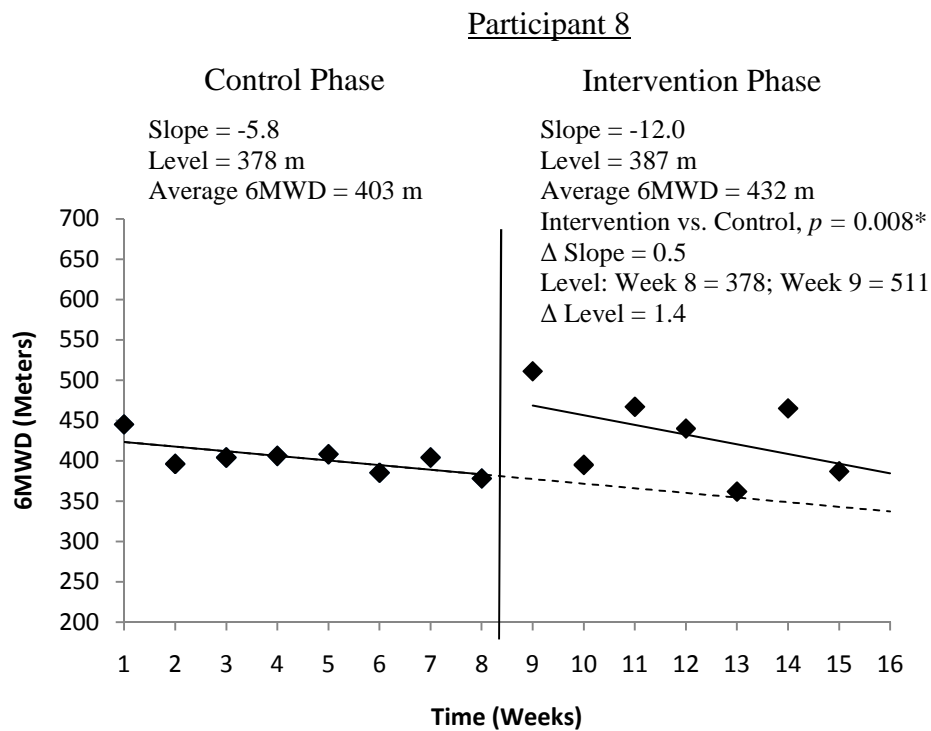


Figure 29: Participant 8 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.008$ ) in 6MWD detected between the two phases. Participant 8 was a 20-year-old male. His 6MWD slope was -5.8 in the control phase and -12.0 in the intervention phase. His average 6MWD increased by 29 m from the control to intervention phase. A significant difference in the hypothesized direction was detected between the two phases.

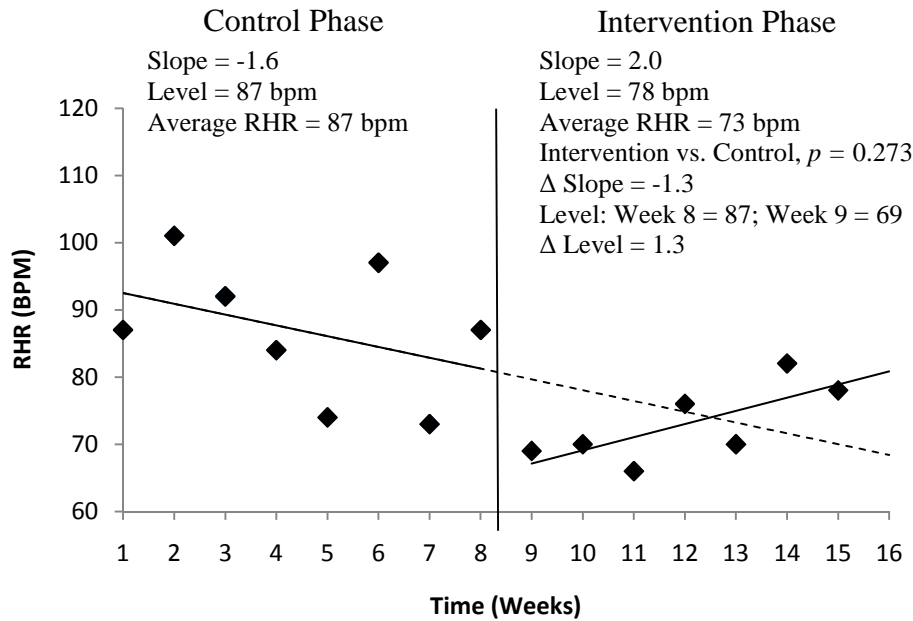


Figure 30: Participant 8 showed no significant difference between the control and intervention phases ( $p = 0.273$ ) in RHR. Participant 7 had a RHR slope of -1.6 in the control phase and 2.0 in the intervention phase. His average RHR decreased by 14 bpm from the control to intervention phase. Due to the negative slope of the control phase, the substantially decreased average RHR in the intervention phase did not result in a significant difference between the two phases.



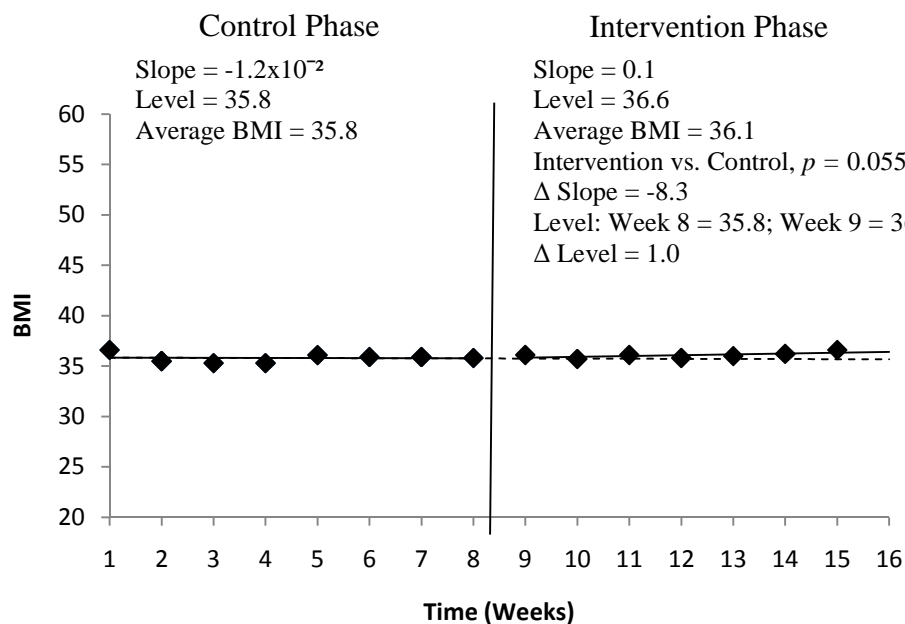


Figure 31: Participant 8 showed no significant difference between the control and intervention phases ( $p = 0.055$ ) in BMI. Participant 8 had a slightly negative BMI slope of  $-1.2 \times 10^{-2}$  in the control phase and a slightly positive slope of 0.1 in the intervention phase. The average BMI increased by 0.3 from the control to intervention phase. No significant difference was detected between the two phases.

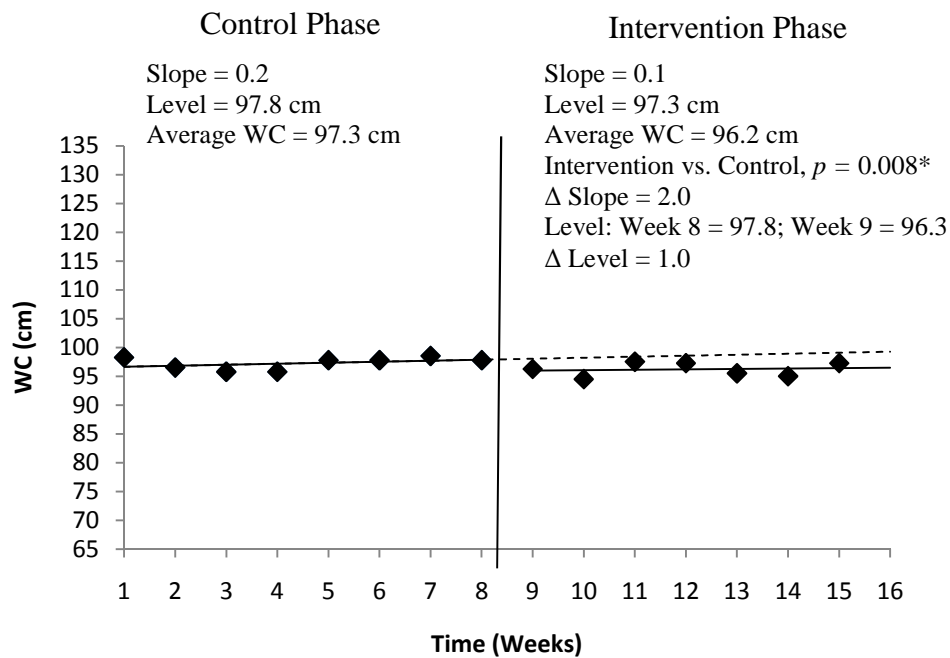


Figure 32: Participant 8 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.008$ ) in WC detected between the two phases. Participant 8 had a WC slope of 0.2 in the control phase and 0.1 in the intervention phase. His average WC decreased by 1.3 cm from the control to intervention phase. A significant difference was found in the hypothesized direction between the two phases.

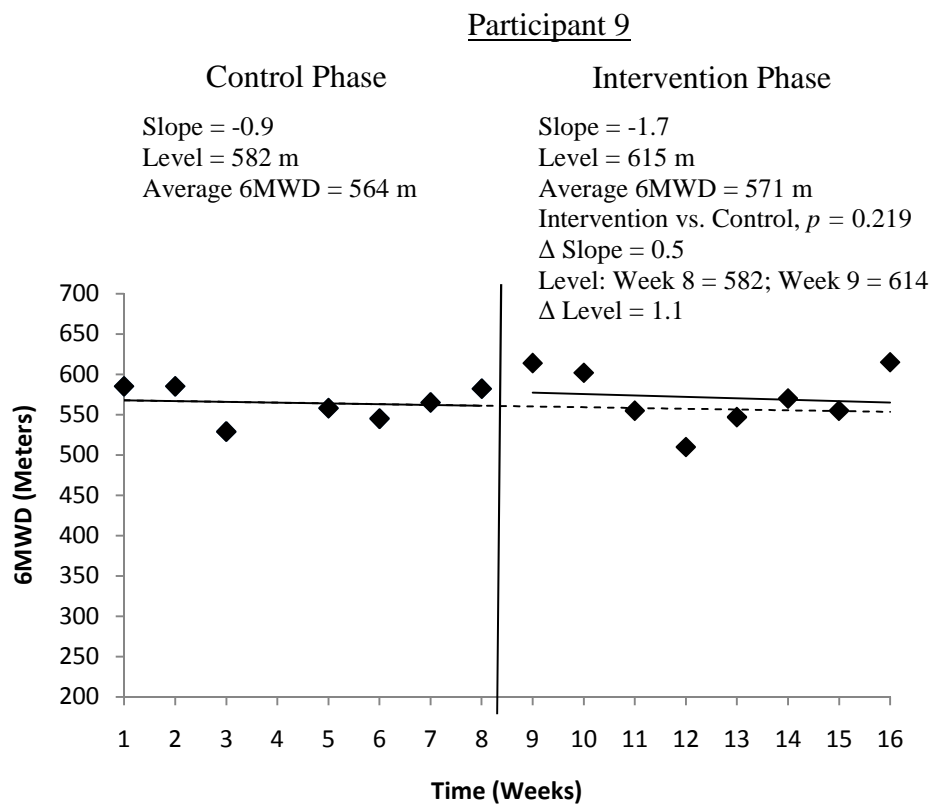


Figure 33: Participant 9 showed no significant difference between the control and intervention phases ( $p = 0.219$ ) in 6MWD. Participant 9 was a 17-year-old female. Her 6MWD slope was -0.9 for the control phase and -1.7 for the intervention phase. Her average 6MWD increased slightly, by 7 m, from the control to intervention phase. No significant difference was detected between the two phases.

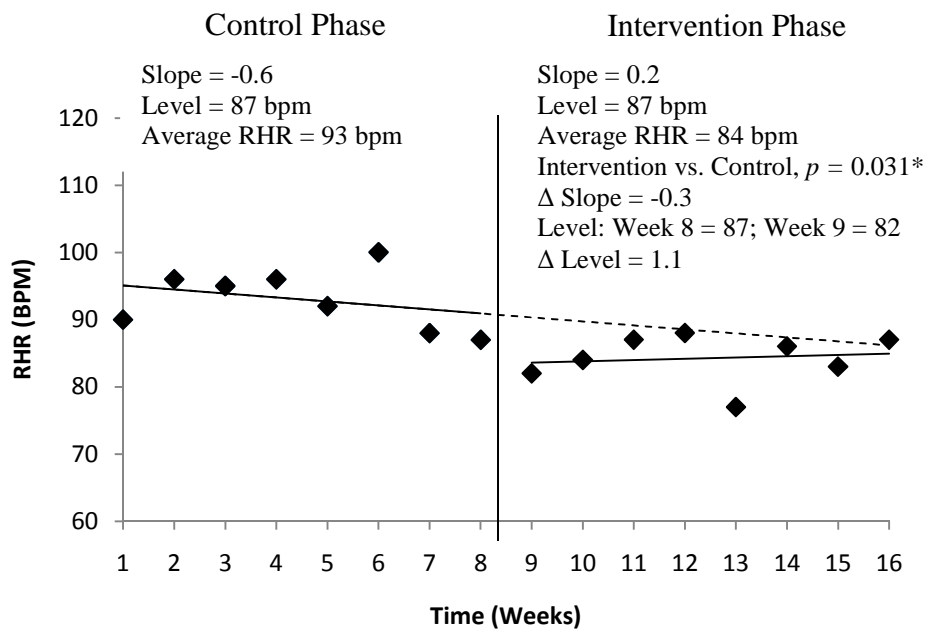


Figure 34: Participant 9 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.031$ ) in RHR detected between the two phases. Participant 9 had a RHR slope of -0.6 for the control phase and 0.2 for the intervention phase. Her average RHR decreased by 9 bpm from the control to intervention phase. A significant difference in the hypothesized direction was found between the two phases.

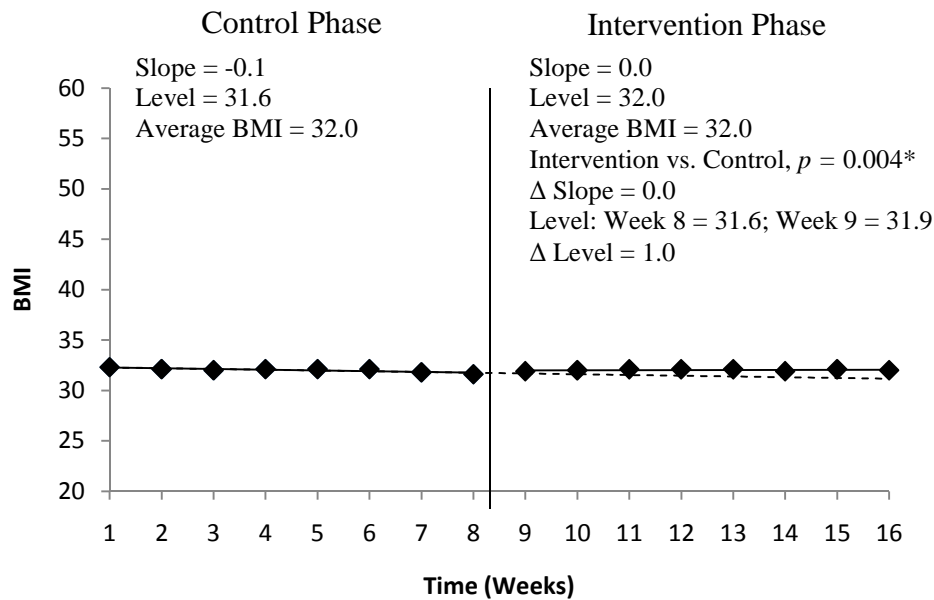


Figure 35: Participant 9 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.004$ ) in BMI detected between the two phases. Participant 9 had a BMI slope of -0.1 in the control phase and 0.0 in the intervention phase. Her average BMI remained constant between the two phases. A significant difference opposite the hypothesized direction was found between the two phases.

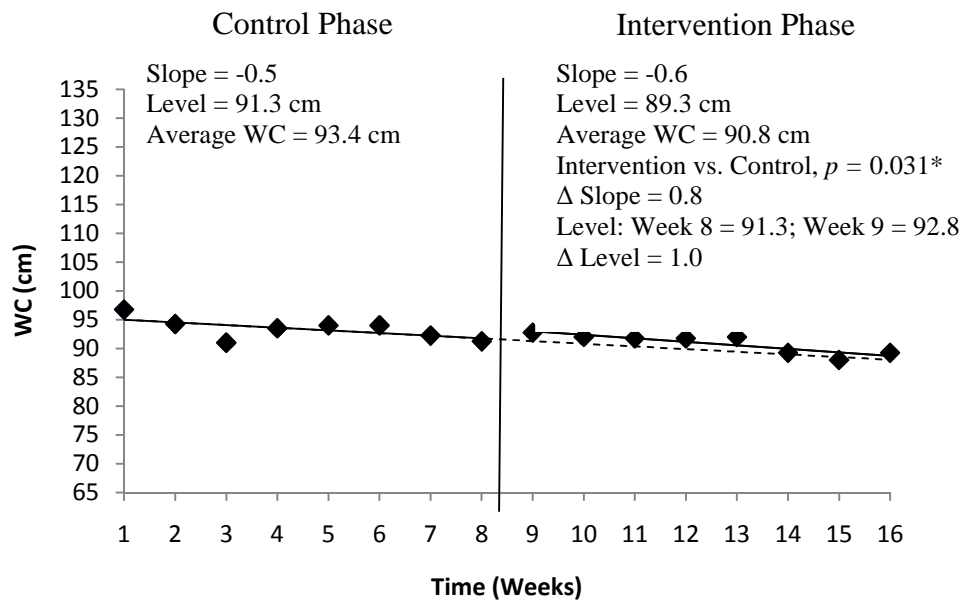


Figure 36: Participant 9 comparison between the control phase and the intervention phase with a significant difference ( $p = 0.031$ ) in WC detected between the two phases.

Participant 9 had a WC slope of -0.5 in the control phase and -0.6 in the intervention phase. Her average WC decreased by 2.6 cm from the control to intervention phase. A significant difference in the non-hypothesized direction, however, was found between the two phases.

Table 2: Summary of Significant Differences Between Control and Intervention Phases for Each Participant and Each Health-Related Fitness Dependent Variable.

Participant	Significance ( <i>p</i> -value)			
	6MWD	RHR	BMI	WC
1	0.234	0.313	0.313	0.094
2	0.094	0.273	0.164	0.164
3	0.016*+	0.234	0.016*-	0.016*+
4	0.004*+	0.109	0.031*-	0.004*-
5	0.004*+	0.031*+	0.031*-	0.273
6	0.004*-	0.004*+	0.109	0.004*+
7	0.031*-	0.109	0.008*-	0.004*+
8	0.008*+	0.273	0.055	0.008*+
9	0.219	0.031*+	0.004*-	0.031*-

\* *p*-value <0.05

+ significance occurred in the hypothesized direction

– significance occurred opposite the hypothesized direction

The hypothesized changes in the intervention phase as compared to the control phase were increases for 6MWD, and decreases for RHR, BMI, and WC.

Table 3: Condition Comparison of Time Spent in Target Heart Rate Zone (THRZ). THRZ was assessed for 5 minute periods (300 seconds) during the main activity on weeks 4, 6, and 8 of each study phase. The main activity in the control phase was always a game incorporating the object control skills being practiced that week. In the intervention phase, the main activity was always a tag game. The average percent of time spent in THRZ for the nine participants was 38% higher in the intervention phase than the control phase. All time spent out of the THRZ was below the THRZ lower limit.

<b>Condition</b>	<b>Avg. # of Seconds in THRZ</b>	<b>Avg. % of Time in THRZ</b>
Control Phase	117 seconds	39%
Intervention Phase	232 seconds	77%



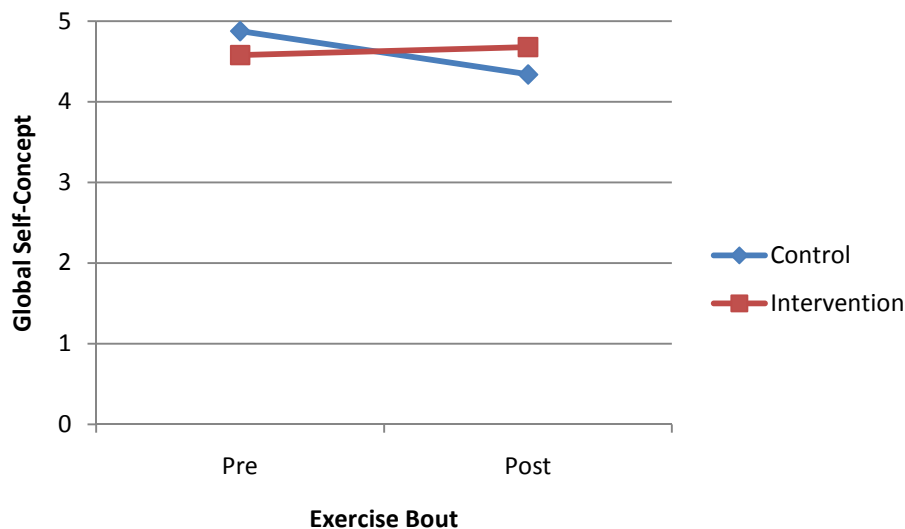


Figure 37: Experimental phase by exercise interaction,  $p = 0.040$ , for the global self-concept scale item number 2. In the control phase, the mean global self-concept value decreased from pre- to post- exercise bout. In the intervention phase, however, the mean global self-concept value increased from pre- to post-exercise bout. After testing for normality, one of the variables included in the three-way RM ANOVA (e.g., the average global self-concept item 2 score before exercise and during the second four weeks of the control phase) was slightly negatively skewed, which necessitates a cautious interpretation of all F ratios and p values. However, the single score that was skewed was part of the time factor (e.g., first four weeks vs. second four weeks of the control phase), and there were no significant main or interactive effects of time. By contrast, there was a significant experimental phase by exercise bout interaction for global self-concept item 2 ( $p = 0.040$ ). Therefore, the normality of mean values was assessed for every variable in the two-way interaction between the experimental phase and exercise bout for global self-concept item number 2, and there were no violations of the normality assumption. All tests for normality included assessment of the skewness/standard error of skewness ratio and the kurtosis/standard error of kurtosis ratio.

## CHAPTER 5

### DISCUSSION

The purpose of this study was to determine whether the *Achilles Kids* endurance training program is more efficacious than a usual adapted physical education program on health-related components of fitness or on global self-concept in adolescents and young adults with intellectual disabilities in Salt Lake City, UT. The four health-related fitness variables will be discussed in regard to trends noticed for participants who achieved significant *p*-values in each of the measures. The global self-concept measure will be evaluated. Limitations will be summarized, and future directions will be explored.

#### Health-Related Fitness Variables

##### Cardiorespiratory Fitness Variables

Six of the 9 participants had trends of greater CRF during the intervention than during the control phase ( $p \leq 0.031$ ). Four of these six participants with intervention-related CRF improvements had longer 6-minute walk distances (6MWD) during the intervention than during the control phase. Three of these six participants with CRF improvements had lower RHRs during the intervention than during the control phase. 6MWD and RHR will be discussed individually in more depth below.

### Six-Minute Walk Distance

Six of the nine participants experienced significant differences in their 6MWD between the control and intervention phases. Four of the six significant differences occurred in the hypothesized direction, in which all or most of the data points in the intervention phase fell above the continued celeration line from the control phase. Three of the four participants with significant differences in the hypothesized direction were male, which presents an interesting potential gender effect. None of the females demonstrated significant differences in the hypothesized direction. It was noted that these three males were generally more motivated and competitive than their classmates.

One of the two participants with significant differences in the nonhypothesized direction had the lowest IQ of the participants in this study. He did not fully understand the concept of pushing himself and testing his limits. The other participant with significant differences in the nonhypothesized direction had the highest BMI of the participants in this study and rapidly became fatigued. The three participants with no significant differences between the two phases were all female, and tended to let their moods affect their performance.

Elmahgoub et al. (2009) found statistically significant increases in 6MWD in 15 adolescents with intellectual disabilities as a result of a 10-week combined exercise training program. This combined exercise training program included both aerobic and strength training components. Perhaps there was more energy expenditure in this study because of the two different modes of exercise training. With strength training you can get a boost in strength and fat free mass. If the individual is stronger and has more muscle mass there is a better likelihood that the individual will do more exercise outside

of the training program. With more fat free mass there would be a higher resting metabolic rate which would contribute to the overall energy expenditure. Therefore the energy expenditures in these two studies are not comparable.

The most challenging aspect of using the 6MWT was that many participants obtained high 6MWD values during the first testing day due to the novelty factor of the test. After completing the 6MWT week after week, the idea of the test became boring, which affected the motivation level for several of the participants. That being said, most alternative cardiorespiratory fitness measurements require either an increased amount of time, distance, or intensity and are not suitable measures for a population of adolescents and young adults with intellectual disabilities.

### Resting Heart Rate

Three of the nine participants obtained significant differences in their RHR values between the control and intervention phases. All three of these significant differences occurred in the hypothesized direction, in which all or most of the RHR data points in the intervention phase fell below the celeration line continued from the control phase. Two of the participants with significant values were male, and one was female. No obvious trends can be seen that link participant demographics to significant RHR values.

Halle et al. (1999) found statistically significant decreases in RHR in eight youth with intellectual disabilities as a result of a 10-week peer-mediated aerobic exercise program. It is important to note that Halle et al. prescribed individualized exercise intensity by monitoring whether or not the participants' heart rates fell into their target heart rate zones (THRZ), and by making the changes necessary to bring the participants

into their zones. THRZ was monitored less frequently in this study, and was not used to individually prescribe exercise intensity. Additionally, Halle et al. used a range of 70-85% of heart rate reserve in their THRZ calculations compared to the 40-84% of heart rate reserve used to calculate THRZ in this study. Overall, it is evident that the intensity for which the participants completed the exercise in the Halle et al. study was greater than the intensity for this study, which is likely why more participants in the Halle et al. study obtained statistically significant decreases in resting heart rate as compared to this study.

Measuring RHR presented challenges due to the fact that the participants had difficulty settling down at times. Additionally, there were times when the watches stopped picking up the signals and RHR values had to be measured by the tester. Utilizing the average of three RHR values, however, helped to provide more accurate measurements.

### Target Heart Rate Zone

Study participants, on average, spent 77% of their sampled exercise bouts within the THRZ during the intervention phase and only 39% of their sampled exercise bouts within the THRZ during the control phase. One of the benefits of the *Achilles Kids* guided running program is the selection of activities that limit time spent standing around. Continuous movement is promoted, which is evidenced by the 38% increase in time spent in THRZ during the *Achilles Kids* guided running program as compared to the usual care control. In comparison, Faison-Hodge and Porretta (2004) found that youth with intellectual disabilities spent only 21-28% of their adapted physical education time in their THRZ. The 77% of time spent in THRZ during the intervention phase of this

study is a substantial increase from Faison-Hodge and Porretta's findings, which supports the use of a program similar to the *Achilles Kids Run to Learn* program.

### Body Composition Variables

Four of the nine participants had trends of smaller WCs during the intervention than during the control phase ( $p \leq 0.031$ ). Two of these four participants with intervention-related reductions in WC also had trends of *greater* BMIs during the intervention than during the control phase, which likely reflects the inability of BMI to differentiate between intervention-related *reductions* in fat mass and intervention-related *increases* in skeletal muscle mass. BMI and WC will be discussed individually in more depth below.

### Body Mass Index

Five of the nine participants had significant differences in BMI between the control and intervention phases. However, all five of these participants had significant differences in the non-hypothesized direction, in which all or most of the BMI data points in the intervention phase fell above the celeration line continued from the control phase. Four of the five participants with significant BMI differences in the nonhypothesized direction were Hispanic, meaning that all of the Hispanic students in this study fell into this category.

It is possible that due to limited opportunities to be involved in recreation over the summer, these Hispanic students were affected by the usual care adapted physical education control. This effect led to slightly negative BMI slopes in the control phase,

which made it difficult for the fairly flat-lined intervention data points to fall on or below the continued acceleration line from the control phase. Additionally, two of these students may have gained skeletal muscle mass, rather than fat, for which BMI does not account. This possibility is evidenced by the significant difference in WC between the two phases in the hypothesized direction for these two participants.

Elmahgoub et al. (2009) found significant decreases in BMI in 15 adolescents with intellectual disabilities as a result of a 10-week combined exercise training program. Although our study did not find significant decreases in BMI, our study also did not contain a strength training component, which the Elmahgoub et al. study did contain.

### Waist Circumference

Six of the nine participants had significant differences in WC between the control and intervention phases. Four of these significant differences occurred in the hypothesized direction, in which all or most of the data points in the intervention phase fell below the acceleration line continued from the control phase. Three of the four participants with significant differences in the hypothesized direction were Caucasian males. This trend may be a result of maturation differences between genders, and increased physical activity levels of Caucasian males compared to females and other ethnicities. Further demonstrating this point is the fact that the two participants with significant differences between the phases in the non-hypothesized direction are Hispanic females.

Elmahgoub et al. (2009) found significant decreases in WC in 15 adolescents with intellectual disabilities as a result of a 10-week combined exercise training program. Our

WC findings are fairly consistent with Elmahgoub et al.'s, but as stated previously, the energy expenditures between these two studies are not comparable because of the likely increase in energy expenditure with two different modes of exercise training in the Elmahgoub et al. study.

### Global Self-Concept

The first global self-concept item revealed no significant interactions, whereas the second item revealed a significant two-way interaction between condition and exercise. Psychological variables are difficult to measure in populations with individuals with intellectual disabilities. This difficulty is largely attributed to a lack of understanding of the questions or statements provided.

The participants in this study could read the statements for which they were circling faces, but did not necessarily understand the meaning of the faces despite being reminded of the meaning each Friday. IQ level certainly affected the comprehension of the global self-concept graphical scale, which is not surprising by any means. The participants with lower IQs tended to circle the same face every time or randomly circle faces across the scale. Additionally, these students often viewed the faces solely as happy versus sad, rather than attaching the meaning of the faces to the global self-concept item. Due to the fact that the scale was developed in France, the statements used may need to be changed slightly to be made more relevant for individuals in this country.



### Limitations

Several of the split plot middle graphs show trends in the control phase, which reduces the accuracy of the binomial technique used to determine significance. The researcher believes that the control phase slopes may have resulted from a lack of physical activity of the participants in the summer, which led to increasing 6MWD values and decreasing RHR, BMI, and WC values once the usual care adapted physical education control was introduced.

As mentioned previously, 8-week phases were not long enough to see substantial differences in many of our health-related fitness variables. Additionally, due to the fitness testing taking up most of the time on Wednesdays, minimal physical activity was conducted on those days. Although the 6MWT required the students to be physically active, the other three measures were fairly sedentary.

Conducting the intervention phase during the colder months, in which Thanksgiving break occurred and Christmas preparations were being made, may have negatively impacted the data in the intervention phase. The participants were likely to receive less physical activity outside of school during the colder months, and were likely to eat more nutritionally poor food due to the holidays. However, significant differences that were seen in the hypothesized direction are that much more impressive due to the uphill battle that was being fought by the intervention phase.

### Future Directions

There are several suggestions for future studies in this area, many of which were realized while designing this study, but were not able to be implemented for various reasons such as time constraints and lack of resources. Further studies in this area should

utilize longer study phases, a larger number of participants, and additional measures in order to paint a more complete picture of the effect of the program on health-related fitness variables and self-concept.

#### Length of Study Phase

The use of a 16-week control phase and a 16-week intervention phase would allow for the researchers to obtain twice as many data points, and to more evenly distribute the seasons within the phases. Additionally, two of the health-related fitness variables, the 6MWD and the RHR, are more likely to significantly change over a longer period of time. Biologically, it typically takes from 4 to 6 months to make significant changes in WC and BMI.

#### Number of Participants

Although using nine participants is more than is typically used by researchers with this population, the use of a larger number of participants will increase generalizability and help to better understand the trends. Conducting the study at multiple schools will additionally allow for a better look into the effects of various locations on the efficaciousness of the particular intervention program being implemented.

#### Additional Measures

Although BMI was easier to use in this study, a measurement that directly quantifies percent body fat is advisable. As seen in this study, five of the participants had

significant BMI differences between study phases in the nonhypothesized direction. It would be helpful to know if, in fact, the BMI increase is attributed to increased skeletal muscle mass or body fat. Bioelectrical Impedance Analysis is likely the best option for body fat percentage analysis in this population due to its low cost, accessibility, and minimal chance of causing participant fear.

Monitoring physical activity outside of school would allow the researchers to be more confident that the intervention is the reason for the changing values. Additionally, a dietary assessment would provide insight as to why weight gain or loss may be occurring.

#### Additional Reinforcement

The students were most motivated by running the laps during the intervention phase because they understood that running the laps would allow them to earn stamps for their maps and get them closer to completing their virtual marathon. If stamps were earned for completing the 6MWT, there is a chance that the students would have been more motivated to complete laps. In the future, reinforcing more of the activities with stamps may lead to increased motivation and participation in those activities.

#### Gender Separation

During this study, the researchers noticed that the male participants were motivated by different strategies than the female participants. The male participants were generally very competitive, which led to their constant movement during tag games and relays. The female participants were more motivated by listening to music while they played games. In the future, reinforcement techniques for male participants should

include opportunities to compete. For female participants, reinforcement techniques should include opportunities to listen to music while participating in physical activity.

### Implications and Summary

The *Achilles Kids Run to Learn* program served as a motivating way to encourage high school students with intellectual disabilities to participate in cardiorespiratory fitness-related activities. Many significant findings arose from this study. Six of the nine participants had trends of greater CRF during the intervention than during the control phase ( $p \leq 0.031$ ). Four of these six participants with intervention-related CRF improvements had longer 6-minute walk distances (6MWD) during the intervention than during the control phase. Three of these six participants with CRF improvements had lower RHRs during the intervention than during the control phase. Four of the nine participants had trends of smaller WCs during the intervention than during the control phase ( $p \leq 0.031$ ). Two of these four participants with intervention-related reductions in WC also had trends of *greater* BMIs during the intervention than during the control phase, which likely reflects the inability of BMI to differentiate between intervention-related *reductions* in fat mass and intervention-related *increases* in skeletal muscle mass. Taken together, seven of the nine participants had evidence of some intervention-related improvement in 6MWD, RHR, or WC ( $p \leq 0.031$ ). Furthermore, study participants, on average, spent 77% of their sampled exercise bouts within the THRZ during the intervention phase and only 39% of their sampled exercise bouts within the THRZ during the control phase. There was also a significant two-way interaction between the experimental phase and acute exercise in the second global self-concept item ( $p = 0.040$ ),

such that the exercise bouts yielded a greater increase in the second global self-concept item during the intervention than during the control phase. The *Achilles Kids Run to Learn* program may help to improve the health-related fitness and global self-concept of adolescents and young adults with intellectual disabilities. However, future trials of longer duration and in multiple schools and with progressively increasing doses of exercise are needed to fully document the efficacy of the *Achilles Kids* program.

It is also important to note that items that were not included in the results section made the study very fulfilling for the researchers. The students were constantly asking if they would have the opportunity to run their laps each day to mark on their *Achilles Kids* virtual marathon maps. Students who missed a session were eager to make up their laps, and get back on track with the rest of their class. Running was no longer a chore, but rather an activity that would launch these students closer to achieving their goal of completing the virtual marathon. Students who were initially only able to run one lap were running six laps by the end of the intervention phase.

On the last day of the intervention, the classroom teacher genuinely said that she hopes the results show how much her students have improved because she can tell that the intervention has made a substantial impact on their lives. The fact that the classroom teacher has a PhD in Adapted Physical Education helped her to see the true value of this particular study. She mentioned that she noticed an increase in on-task behaviors, decrease in acting-out behaviors, and an increase in students' willingness to work hard and do what was asked of them. The students had better alertness after doing the planned physical activity and their overall mood was better. Overall, she felt that this *Achilles Kids* program was a very positive and rewarding experience for her students. Although

none of these variables were measured, this anecdotal information was encouraging and may provide impetus to measure these variables in future studies.

## APPENDIX A

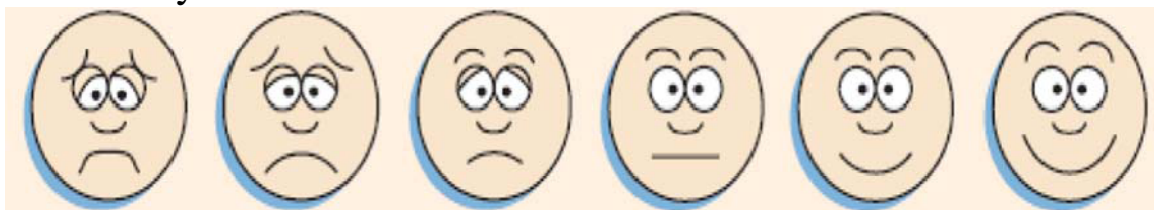
### GLOBAL SELF-CONCEPT SCALE

Name:

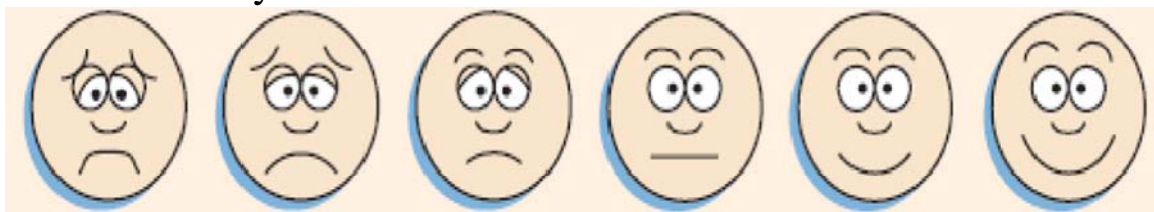
Date:

PRE

1. I like myself

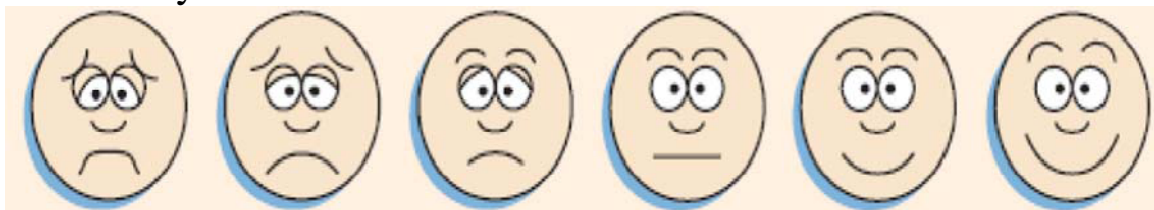


2. I want to stay as I am

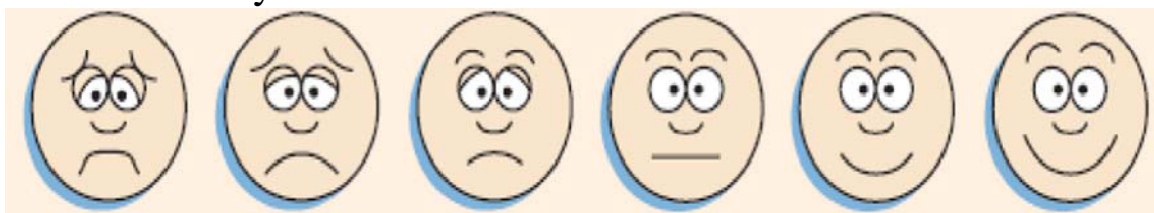


POST

1. I like myself



2. I want to stay as I am





## APPENDIX B

### PARENTAL PERMISSION FORM

## **Consent and Parental Permission Document**

### **BACKGROUND**

Your son or daughter is being invited to take part in a research study by a Master's student from the University of Utah for a thesis project. Before you decide whether to allow your son or daughter to participate it is important for you to understand why the research is being conducted and what will be involved. Please take time to read the following information carefully to decide whether you will allow your son or daughter to take part in this study. Feel free to ask questions if anything is unclear or if you would like more information.

Obesity in adolescents and young adults has become more common. Physical activity in the form of running and walking may help to decrease the health risks associated with inactivity. *Achilles Kids* is part of the *Achilles International* distance running organization for individuals with intellectual and physical disabilities. *Achilles Kids* has a program called *Run to Learn*, which is implemented into adapted physical education classes to encourage children with special needs to run, walk, or roll. Throughout the year, the students complete a virtual marathon and keep track of their progress on maps, lap charts, and training log books provided by *Achilles Kids*. This research study will compare the benefits of this *Run to Learn* program on four fitness components and global self-concept to those resulting from a regular adapted physical education class.

### **STUDY PROCEDURE**

If you choose to sign this permission form, you will be required to complete a brief health history questionnaire to ensure that it is safe for your son or daughter to participate in the study.

During this study, your son or daughter will visit with me during the school day morning, along with personnel who are trained to work with adolescents and young adults with intellectual disabilities. Your son or daughter will visit with me three days per week for the duration of sixteen weeks. The length of each meeting time will be one hour. These meetings will begin on August 29, 2011.

Your son or daughter, with your permission, will be tested on cardiorespiratory fitness, resting heart rate, body mass index, and waist circumference every Wednesday. To measure cardiorespiratory fitness, your son or daughter will have six minutes to walk down and back along a 30 meter section of a hallway as many times as he or she can. To measure heart rate, a watch and chest strap will be placed on your son or daughter for approximately ten minutes at the beginning of each Wednesday session. Body mass index will be measured by gathering your son or daughter's height and weight and inserting those values into an equation. Lastly, waist circumference will be measured by placing a tape measure around your son or daughter's waist. Self-concept will be measured every Friday before and after each exercise session. To measure self-concept, your son or daughter will circle which facial expression best depicts how he or she feels about the following two statements: 1) "I like myself" and 2) "I want to stay as I am."

During the first eight weeks of the study, your son or daughter will receive a regular adapted physical education class. During the last eight weeks of the study, your son or daughter will receive the *Run to Learn* running program discussed previously. There will

be approximately ten other students from Terrie Rauzon's class participating in the research study.

### **RISKS**

The risks of this study are minimal. Your son or daughter may feel some discomfort in joints and muscles as they become used to walking and running more than they previously did. They also may become out of breath while walking or running. If you decide to have your son or daughter participate in this study, you will be asked to complete a health history questionnaire about any health conditions such as heart problems, asthma, etc. that may put your child at risk in this study. If there is any medical condition that could negatively impact your son or daughter they may be excluded from the study for their own safety.

If your son or daughter is injured during a study session, we will follow the injury procedures that are in place at East High School. For instance, you will be called and an accident report will be completed. If you feel your son or daughter should see a doctor after the incident, you are free to take him or her to the doctor. If the injury appears to be serious enough to need prompt medical care, an ambulance will be called by an administrator. The paramedics will be told about your preferred hospital, which you have on file with Dr. Terrie Rauzon.

### **BENEFITS**

We cannot promise any direct benefit to your son or daughter as the result of taking part in this study. However, possible general benefits include increased motivation to run, increased cardiorespiratory fitness, learning how to set goals, and an improved self-concept. We also hope that the information we obtain from this study will help us gain a deeper understanding of how to promote physical fitness among children with intellectual disabilities and to discover the benefits to them of being more physically fit. We will provide you with a report, which explains your son or daughter's fitness and self-concept changes throughout the study.

### **ALTERNATIVE PROCEDURES**

Your son or daughter does not have to take part in this study. If either you or your son or daughter decides to stop participating, you may do so at any time without penalty. If your son or daughter is not participating in the study, he or she will spend that time in Terrie's classroom.

### **CONFIDENTIALITY**

Your son or daughter's records concerning this research study will be stored in a locked filing cabinet or on a password-protected computer located in the researcher's office (HPER W 102). Only the researcher and members of her study team will have access to this information. A number will identify your son or daughter during the study so his/her real name will not be in any of the records. The data will be kept confidential.

### **PERSON TO CONTACT**

If you have questions, complaints or concerns about this study, you may contact Claire de Gennaro at (801) 541-7837. If you feel your child has been harmed as a result of participation, please call Dr. Hester Henderson, who may be reached during the hours of 8-5pm Mondays through Fridays, at (801) 581-7964.

**Institutional Review Board:** Contact the Institutional Review Board (IRB) if you have questions regarding your son or daughter's rights as a research participant. Also, contact

the IRB if you have questions, complaints or concerns which you do not feel you can discuss with the investigator. The University of Utah IRB may be reached by phone at (801) 581-3655 or by e-mail at [irb@hsc.utah.edu](mailto:irb@hsc.utah.edu).

**Research Participant Advocate:** You may also contact the Research Participant Advocate (RPA) by phone at (801) 581-3803 or by email at [participant.advocate@hsc.utah.edu](mailto:participant.advocate@hsc.utah.edu).

### **VOLUNTARY PARTICIPATION**

It is up to you to decide whether to allow your son or daughter to take part in this study. Refusal to allow your son or daughter to participate, or the decision later on to withdraw your son or daughter from this research, will involve no penalty or loss of benefits to which your son or daughter is otherwise entitled. This will not affect you or your son or daughter's relationship with the school or investigator.

### **COSTS AND COMPENSATION TO PARTICIPANTS**

There are no costs to participate in this study. Your son or daughter will receive a map, lap chart, training log book, t-shirt, and certificate for participating in this study.

### **CONSENT**

By signing this consent form, I confirm I have read the information in this parental permission form and have had the opportunity to ask questions. I will be given a signed copy of this parental permission form. I voluntarily agree to allow my son or daughter to take part in this study.

\_\_\_\_\_  
Son or Daughter's Name

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Parent/Guardian's Name

\_\_\_\_\_  
Parent/Guardian's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Relationship to Child

\_\_\_\_\_  
Name of Person Obtaining Consent

\_\_\_\_\_  
Signature of Person Obtaining Consent

\_\_\_\_\_  
Date

## APPENDIX C

### ASSENT FORM TO PARTICIPATE IN THE STUDY

## Assent to Participate in a Research Study

### **Who are we and what are we doing?**

We are from the University of Utah. We would like to ask if you would be in a research study. A research study is a way to find out new information about something. This is the way we will try to find out if the *Achilles Kids* running program works.

### **Why are we asking you to be in this research study?**

We are asking you to be in this research study because we want to learn more about how the *Achilles Kids* running program will change your fitness and how you feel about yourself. We want you to be in this study because this running program has been created to help kids like you and your classmates enjoy running.

### **What happens in the research study?**

If you decide to be in this research study and your parent or guardian agrees, these are the things that will happen:

- We will come to your class three mornings each week to provide you with a regular adapted P.E. class for the first eight weeks and a running class for the last eight weeks.
- We will ask you to participate in these programs, and let us take measurements from you every Wednesday and Friday.
- We will look at your fitness, how fast your heart beats, your height and weight, and your waist size each week.
- We will ask you how you feel about yourself before and after each class.
- You will be in the study for sixteen weeks, starting on August 29, 2011.

### **Will any part of the research study hurt you?**

There is a chance that during this research study you could feel pain in your joints or muscles from running more than you are used to. You also may become out of breath while running. We will try to help you feel better if this happens. You can stop at any time if you want to.

### **Will the research study help you or anyone else?**

We do not know for sure if being in this research study will help you, but hope that it will help you learn to enjoy running, make you more fit, improve how you feel about yourself, and teach you how to set goals. We may also learn something to help other people like you and your classmates enjoy running and

become more fit.

**Who will see the information about you?**

Only the researchers will be able to see the information about you from this research study. We will not tell anyone else that you are in the study.

**What if you have any questions about the research study?**

It is okay to ask questions. If you don't understand something, you can ask us. We want you to ask questions now and anytime you think of them. If you have a question later that you didn't think of now, you can call Hester L. Henderson at 801-581-7964 or Claire de Gennaro at 801-541-7837 or ask us the next time we see you.

**Do you have to be in the research study?**

You do not have to be in this study if you don't want to. Being in this study is up to you. No one will be upset if you don't want to do it. Even if you say yes now, you can change your mind later and tell us you want to stop.

You can take your time to decide. You can talk to your parent or guardian before you decide. We will also ask your parent or guardian to give their permission for you to be in this study. But even if your parent or guardian says "yes" you can still decide not to be in the research study.

**Agreeing to be in the study**

I was able to ask questions about this study. Signing my name at the bottom means that I agree to be in this study. My parent or guardian and I will be given a copy of this form after I have signed it.

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Printed Name

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Sign your name on this line

---

Date

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Printed Name of Person Obtaining Assent

---

Signature of Person Obtaining Assent

---

Date

The following should be completed by the study member conducting the assent process if the participant agrees to be in the study. Initial the appropriate selection:

\_\_\_\_\_ The participant is capable of reading the assent form and has signed above as documentation of assent to take part in this study.

\_\_\_\_\_ The participant is not capable of reading the assent form, but the information was verbally explained to him/her. The participant signed above as documentation of assent to take part in this study.



## APPENDIX D

### HEALTH HISTORY QUESTIONNAIRE

University of Utah Adapted Physical Education Program  
Health History Questionnaire

1. Please list your son or daughter's date of birth:

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2. Please list your son or daughter's ethnicity (eg, Caucasian, Hispanic, Asian, etc.):

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MUSCULOSKELETAL HEALTH ISSUES:

3. Does your son or daughter have any current musculoskeletal problems that limit his or her physical activity? *if so, please list them:*

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CARDIOVASCULAR HEALTH ISSUES:

4. Does your son or daughter have a congenital heart defect? *if so, please list the specific defect, if it has been repaired by surgery, and when it was repaired by surgery:*

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**PULMONARY HEALTH ISSUES:**

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5. Does your son or daughter have asthma? *if so, please list the potential triggers (eg, allergies, exercise, etc.) and how this is treated (eg, inhaler, specific medication and dosage, etc.):*

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**ENDOCRINE HEALTH ISSUES:**

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6. Does your son or daughter have diabetes? *if so, please list type-1 or type-2 and how this is treated (eg, diet, specific medication and dosage, etc.):*

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**NEUROLOGICAL HEALTH ISSUES:**

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7. Does your son or daughter have epilepsy? *if so, please list the frequency, duration, and severity of his or her seizures, when the last seizure occurred, and any medications (including dosage) used to treat this disorder:*

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**GENERAL HEALTH ISSUES:**

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8. Does your son or daughter take prescription or non-prescription medications that have not been listed under the previous questions? *if so, please list them along with their dosage (eg, 20 mg/day of Prevacid; 500 mg/ day of Centrum multivitamin for women; 1,000 mg of Tylenol/day):*

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9. Has your son or daughter had any surgeries or hospitalizations? *if so, please list surgery or reason for hospitalization and month/year:*

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10. Does your son or daughter have any medical problems that have not been discussed under previous questions? *if so, please list them:*

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11. Has your son or daughter had any accidents or injuries? *if so, please list the type, severity, and date:*

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12. How much physical activity does your son or daughter currently get each week?  
*Please list the type, duration (in minutes), intensity (light, moderate, vigorous), and frequency (in days per week) of exercise he or she receives (eg, 20 minutes of moderate-intensity walking, 3 days per week):*

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13. Do you have any reason to believe that it is unsafe for your son or daughter to participate in this study? *if so, please specify.*

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